Marine Engineering
And Shipping Age

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Marine Engineering
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Build Ships!

THE short session of the Congress is drawing to a close, the Shipping Board has made its report on ways and means for maintaining the merchant marine—and nothing constructive has been accomplished nor does it appear in the least probable that anything will be done towards the construction of new vessels. As usual, much talk, many ideas, no action!

The Shipping Board has been provided with funds to continue as at present—all that seems likely to come of its much heralded construction program is the reconditioning of the *America*—something that any well organized private company would have attended to long ago.

The only really constructive proposal, looking towards the maintenance of the North Atlantic passenger service which the board has ever received has been rejected—there is nothing in sight to take its place. Whatever later Congresses may do it now seems certain that the United States Lines will soon find themselves where effective competition with the new foreign vessels which on every hand are rapidly taking shape will be impossible. Even though the Congress at its next regular session should provide liberally for new construction, years must elapse before replacements can be made. Long before then the United States Lines, as a competitive organization of the first rank, will be in a most difficult, if not impossible, position.

In government circles the opinion has been expressed that the recent charter and purchase proposals had the unanimous approval of the foreign steamship companies—that they were, in effect, a deep scheme to put the United States off of the Atlantic. One cannot but wonder what these same foreign companies think of the position in which the Shipping Board, with the aid of certain members of the Congress, now seems likely to find itself.

If the board could only function as well in building as it does in operating passenger ships, all would be well.

If the Congress will undertake new construction *at once*, all well and good; the question of who will operate the new ships can be settled later. The all important fact is that new vessels must be commenced *now*, if the American flag is to continue to fly over first class Atlantic ships.

No one wants an extra session of the Congress, if it can be avoided, but the shipping situation is critical. Are there not enough broad minded and far seeing men in Washington who can be brought to realize its gravity and who can be made to understand that something constructive *must* be accomplished *now*, even at the expense of an extra session?

Small Cruisers

THE chance of adding ships of real fighting value to the navy appears small at the present time. So long as there is another possible disarmament conference in the offing there is at least a plausible excuse for saving money and for retarding as much as possible the construction of ships having material combat value. To the writer, the probability that the various European powers and Japan will consent to a further material reduction of naval forces seems very remote. Eventually our fleet of modern high speed cruisers will undoubtedly be increased but, for the present, paper ships seem likely to replace steel ones, as far as our navy is concerned.

There is another class of vessel, however, for which, to the layman at least, our navy appears to have a real need—small cruisers. Whether we like it or not, this country has to maintain police duty in Central American waters, and present indications are that this service will have to be maintained for years to come. Large ships have no place here and the new scouts are in every sense large ships, far too costly and expensive to run and also too unhandy for most police duty. Practically the only peace-time cruisers which we have are the ships of the *Denver* class, now 25 years old and presumably pretty well worn out. Moreover they are of 3,000 tons displacement, too large for much of the work alluded to. A gunboat or sloop of say 1,500 tons can do this work more handily and very much more cheaply.

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Naturally the navy wishes to invest such funds as it can obtain from the Congress in effective fighting ships but as these for the present at least are "taboo," could not attention be turned, with advantage, to smaller but very useful vessels with which disarmament propagandists can in no way be concerned?

High Pressure Steam

THE position of the editor of a technical paper has its own difficulties and often is far from being an enviable one. If he is in any degree fair minded and if his paper is to be kept from becoming merely a disbursing medium for various forms of advertising propaganda, his first and paramount duty is to place before his readers all sides of any controversial matter; to give, so far as he is able, all dominant aspects of every subject, divorcing from his editorials his own personal prejudices and eliminating from the discussion his own feelings as regards the personality of the disputants or the merits of their respective cases. On the other hand, the editor, if he has a fair knowledge of the industry which his paper represents, and it is to be presumed that every editor of a technical or semi-technical publication has this knowledge, should be quite capable of forming his own opinion as to the merits of any matter. Once this opinion is formed it is his right and his duty to express it, taking particular care, however, to make clear the foundations upon which his opinion is based.

In every branch of engineering there are many controversial subjects and in practically every instance reasonable arguments may be made on each side of every question which arises. Competition often leads to exaggeration and misstatement of facts and these again are to be found on each side of almost every argument. Each competitor naturally likes to feel that his position is unassailable and too often comes to look upon as questionable any statement commending in the slightest degree the arguments of his opponents. It is the editor's business to get at *all* the facts and present them as clearly as he may, however much he may be accused of "going over to the enemy" or of "carrying water on both shoulders." To the latter accusation he must often plead guilty, for every argument must, in the nature of things, have two sides and it is "up to him" to give due credit to both of them.

The contest between steam and internal combustion engines, now so sharply drawn, is one bristling with difficulties when the attempt is made to draw a fair and unbiased conclusion as to the respective merits of the two forms of prime mover. On the one hand, the Diesel enthusiast would have his audience believe that "all is over but the shouting;" that the steam engine is dead although as yet not fully aware of the fact. On the other hand, the dyed-in-the-wool steam engineer will shake his head and hint darkly of the multitudinous and closely concealed troubles incident to the operation of motorships, their great cost and the rising price of oil fuel. In reality each is stating what he *hopes,* not what he *knows* and each, if he is a real engineer, has, deep down in his heart, a wholesome respect for certain parts, at least, of his opponents' argument although he is most careful not to mention these things himself and is prone to be resentful if anyone else does so. In engineering the "truth" may often have cause to be changed and modified to keep abreast of progress but usually it is to be found somewhere between the limits, pro and con, of all discussions. Thus, on the one hand, the ever increasing number of motorships and the fact that many new vessels of this class are being built for owners already operating motorships casts at least a very reasonable doubt upon reported difficulties of operation, while on the other, the very high efficiency of the modern power house and the relatively low cost of its driving machinery make it seem probable that here, at least, steam is strongly entrenched for many years to come. It cannot be reasonably expected that either form of motive power will be used exclusively for all purposes and under all conditions of operation.

In one respect the marine steam engineer is under obligation to the Diesel. While steam pressures have been increasing and economy has improved, the marine steam plant has, for what appear to be good and sufficient reasons, lagged behind its shore prototype in the matter of thermodynamic efficiency, and it is to the advent of the Diesel and the very great popularity which it has attained in such a short time that the present attempts to improve the marine steam plant are mainly due—the steam engineer has been fully awakened to the fact that if his engine is long to continue in service it must be radically modified and improved.

Elsewhere in this issue there will be found a paper recently read by Sir Charles A. Parsons, the inventor of the steam turbine, before the North East Coast Institution of Engineers and Shipbuilders. This paper is of great interest in its outline of the development of the marine steam turbine; it is of outstanding importance in that it makes public, for the first time, the performance results of the high pressure steamer *King George V,* a vessel which, if the hopes of her designers and builders are entirely fulfilled, marks an epoch in marine engineering. It is very true that "one swallow does not make a summer,"—experience with more than one vessel will be necessary to prove or disprove the value of very high steam pressures and temperatures on shipboard but a beginning has been made and its results are impressive.

At full power the *King George V* consumed 1.085 pounds of ordinary quality coal per shaft horsepower hour. The total shaft power developed was 3,489 and the coal consumed per hour 3,785 pounds. At the present New York rate for bunker coal ($5.80 per ton) this coal would cost $9.04. Now assume a Diesel installation of the same power, consuming approximately 0.42 pound of oil per shaft horsepower hour. The total fuel consumed per hour would be 1,465 pounds and its cost at the present price of Diesel oil at the refiner's pier in New York ($2.40 per barrel) would be $11.40. On the surface it seems apparent that the steamer has a considerable advantage, so far as fuel costs are concerned, at the present time but it must be remembered that the price of neither coal nor oil is

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a fixed quantity and is liable to fluctuations and that a comparatively small change in the relative price of the two fuels would present a quite different picture.

The performance of the *King George V* is a remarkable one, from the marine standpoint, but nothing more than might have been expected by the power plant engineer. Thermodynamic efficiency is, however, but a part of the marine engineer's problem. Reliability and cost of upkeep must, particularly for a commercial, seagoing vessel, be proved satisfactory beyond reasonable doubt before fuel economy can be given equal consideration. All this will take varied experience—and time. Meanwhile the steam engineer has issued a direct challenge to the Diesel. That it will be accepted there can be not the slightest doubt, for the Diesel, in certain trades at least, is pretty evidently here to stay. The ensuing contest will be of consuming interest to the shipowner who, in the final analysis, must pay the bills.

Wear in Diesel Engines

IN a previous article mention was made of certain of the causes of wear and deterioration in marine steam machinery. It is now proposed to consider in a very general way those features of operation which are likely to cause wear in and which, in the main, are confined to the internal combustion engine.

From the fundamental principles upon which it is based —the extremes of both temperature and pressure involved in its cycle of operation—the Diesel lays upon all of its parts and the materials of which they are formed the most trying conditions, particularly in view of the tendency to measure these conditions from the point of view of the steam engineer. The great and sudden variations of pressure call for particular attention to bearings and their efficient lubrication while equally great variations in cylinder temperatures make the form of the cylinder walls and heads and the materials entering into their construction of particular concern. These are, however, matters of fundamental design rather than of operation; problems which are being successfully dealt with, if not yet entirely solved.

Turning to the more practical side of the question, it appears that the principal cause of operating difficulties and wear in the Diesel has a somewhat similar origin to that which rises up to plague its steam-driven predecessor, for while the latter may be brought to grief by the impurities contained in the water supplied to its boilers, the former's difficulties come chiefly from impurities in the fuel fed to its cylinders. In both cases the seat of difficulty and particularly of undue wear and wastage is in the fluid which supplies the driving force.

Probably the presence of sulphur in the fuel oil is the principal cause of undue wear in the Diesel cylinder and the valves connecting with it. This seems to be particularly true with the exhaust valves of four-cycle engines and tends to prevent the use of the heavier and less highly refined fuels in these engines. Following this line of reasoning the two-cycle engine with exhaust ports in the cylinder barrel is put forward as particularly suitable for the use of heavy oil. As a matter of fact both types of engine are liable to damage from the cause mentioned for it appears that the most damage is done not while the engine is running, but when it is standing still and the acids formed have the opportunity of acting upon cylinder walls and piston as well as upon the valves in the cylinder head. It is this fact which has led to the practice, on the part of some operating engineers, of cutting off the regular fuel supply shortly before shutting down their engines and running the latter on kerosene or some similar high grade oil for a sufficient period to clear out all impurities and leave the various surfaces coated with a substance not actively corrosive. When this practice is followed it appears that the heavier types of fuel, at least so far as their sulphur content is concerned, are not particularly harmful to either two- or four-cycle engines.

Aside from their acid-producing constituents, all fuel oils contain in greater or less quantity non-combustible substances leaving, after burning, an ash closely akin to that resulting from the burning of coal and often of a highly abrasive character. Naturally this is more in evidence in heavy than in lighter and more highly refined oils but it is always present in some degree, together with other impurities. Recently the writer visited a very fine British motorship fitted with twin screw two-cycle engines and found to his surprise that although a so-called "Diesel oil" of about 22 degrees Beaumé was used it was all being thoroughly centrifuged before feeding to the engines. Furthermore the chief engineer exhibited a quantity of thick, black paste taken from the fuel with the remark that it could be used to "polish brass." If such a substance can be found in a refined oil, the use of the heavier and presumably more contaminated fuels, without some preparatory cleansing treatment, seems a doubtful economy. Undoubtedly the heavier oils are cheaper but cylinder liners and valves are expensive and a very considerable saving must be realized from the use of cheap oil, if expensive replacements and delays are to be fully offset. In any event the very great value and importance of the centrifugal or other efficient oil separator seem to be well established by such experiences as that mentioned.

Another source of impurities in the Diesel cylinder, not so pronounced as the fuel but nevertheless a possible cause of trouble, lies in the air entering the air intakes of four-cycle engines or the scavenging air inlets of two-cycle engines. To realize the truth of this statement one has but to run his hand over the air inlets to cylinder, air compressor or scavenging pump to find in many if not most cases a surprising amount of dust and dirt. While a considerable portion is deflected by the slots of the intakes it is apparent that much foreign matter must in this manner find its way into the cylinders or pumps and if this dust happens to be of an abrasive character its eventual effect can hardly fail to be harmful. Possibly the damage resulting from the presence of dust in the air taken in by engines and compressors aboardship is not of sufficient importance to warrant the fitting of an air filter but in this connection it is worthy of note that filters are being fitted to the carburetter air intakes on motor cars where the dust conditions are obviously of serious moment.

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forged tools. It thoroughly covers wrenches of all types, eye bolts, chisels, clamps, dogs, ends, extensions, hammers, tool kits, nuts, pliers, punches, ratchets, screw drivers, thumb screws, sets, sleeves, sockets, cotter pin tools, etc. Anyone mentioning this magazine can secure a copy free of cost.

HASKELITE AND PLYMETL.—The third issue of "The Light Weight Champions' Record" which is the house organ of the Haskelite Manufacturing Company, Chicago, manufacturers of Haskelite and Plymetl, has recently been issued. This bulletin is devoted to a description of the uses to which Haskelite and Plymetl are being put in various industries. It contains a special article by James Raymond Fitzpatrick, C. E., secretary and director of sales, on "Building New Markets for Haskelite, War-Born Industrial Product." This article, which was reprinted from the January issue of "Industrial Marketing," deals with a number of applications of this material, including its uses aboard-ship, where it makes a satisfactory bulkhead material for separating staterooms in passenger vessels, and has been used largely in new ship construction and reconditioning work by Atlantic coast and Great Lakes shipyards. A number of notable installations are mentioned including the liners *Leviathan, George Washington* and other United States Lines vessels; the Lake liners *City of Detroit* and *City of Cleveland, III* as well as in the Merchants and Miners and Norfolk and Washington boats. On the west coast, the latest vessels which have adopted Haskelite and Plymetl are the ferryboats for the Key System and the new vessels of the Los Angeles Steamship Company. On the new car ferry *Madison* for the Grand Trunk Railway System, now nearing completion, both Haskelite and Plymetl have been used extensively; on the former for bulkheads, interior side linings, ceilings, etc. and on the latter for exterior doors.

BUSINESS NOTES

L. H. Coolidge and H. C. Hanson, Seattle, Wash., naval architects, have formed a partnership with offices at 117 Grand Trunk dock.

William Z. Gardner, former president of the Propeller Club of the Port of New York, is now located at 136 Liberty street, New York, where he plans to handle advertising and marine publicity work.

Alexander McNab, president of the McNab Company, formerly of Bridgeport, Conn., is now located at No. 1 Broadway, New York. All correspondence regarding McNab marine inventions and auxiliaries should be forwarded to the new address.

The Air Reduction Company, Inc., has acquired, through a long-term lease from the Commercial Acetylene Supply Company, Inc., the plants and business of that company on the Pacific coast. The two acetylene manufacturing plants are located at Berkeley and Los Angeles, Cal., respectively.

George Solz, Jr., has been appointed by the Bridgeport Brass Company, Bridgeport, Conn., to sell their line of tubular plumbing supplies, brass pipe and fittings in Northern New Jersey and the Bridgeport-Keating flush valve in the entire state of New Jersey and Rockland County, New York.

Theodore Beran of New York, H. L. Monroe of Chicago and J. A. Cranston of San Francisco have been appointed commercial vice presidents of the General Electric Company, Schenectady, New York, in charge of the commercial activities of the company in the New York, central, and Pacific coast districts, respectively. E. W. Allen, manager of engineering, was elected vice president in charge of engineering with offices in Schenectady.

Anson Wood Burchard, vice-chairman of the board of directors and chairman of the executive committee of the General Electric Company and chairman of the board of directors of the International General Electric Company, died on January 22 of acute indigestion in New York City. He was 61 years old and was director of several utility and electrical companies and a member of many electrical and power clubs and organizations.

Harry E. Miller has been appointed works manager of the Newark, N. J., plant of the Westinghouse Electric and Manufacturing Company. Mr. Miller entered the employ of the Westinghouse Company at Pittsburgh in 1889 and was assigned to the machine and tool departments and later moved to the erection and test sections. Eleven years later he was transferred to the Newark factory as foreman of the inspection and tests of ampere and watthour meters and fan motors. Mr. Miller continued as an executive of the Newark plant, becoming successively assistant superintendent, superintendent, assistant works manager and finally manager.

James A. Davies, assistant general superintendent of the South Philadelphia Works, Westinghouse Electric and Manufacturing Company, for the past eight years, has been appointed general superintendent to fill the position made vacant by the death of Mr. H. M. Giles, widely known in engineering circles throughout the United States. Alfred Voysey was appointed to the position of assistant general superintendent formerly held by Mr. Davies and James Lyons was promoted to the position of supervising production department vacated by Mr. Voysey.

The American Brass Company announces that arrangements have been completed whereby it will take over the manufacture and sale of Everdur Metal from the Du Pont Everdur Company. Everdur is a trademarked and patented alloy of copper, silicon and manganese. It was developed by the Du Pont Company in their search for a metal that would combine the tensile strength and elastic limit of low and medium carbon steels with good machining and working qualities and high resistance to a large number of corroding agents. This alloy is manufactured by the American Brass Company in the form of casting ingots, plates, sheets, rods and wire, and is also available in the form of washers, bolts, nuts, screws, rivets, wire cloth and castings. It casts readily, can be drop forged, stamped and pressed. The research work conducted by the Du Pont Everdur Company in developing Everdur Metal will be continued by the American Brass Company in the further development of this material for various purposes in their laboratories.

Marine Societies

America

American Marine Association. 30 Church St., New York. President—Col. E. A. Simmons.

American Marine Standards Committee. Chairman, Colonel E. A. Simmons. Secretary, A. V. Bouillon, Division of Simplified Practice, Department of Commerce, Washington, D. C.

American Society of Marine Designers. Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass.

American Society of Marine Engineers. 605 Market St., San Francisco, Calif. President—Benjamin S. Free. Secretary—Wm. H. Thille.

American Society of Naval Engineers. Navy Department, Washington, D. C. Secretary-Treasurer—Commander H. B. Hird, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

American Steamship Owners' Association. 11 Broadway, New York. President—Alfred Gilbert Smith.

Atlantic Coast Shipbuilders' Association. 1600 Walnut Street, Philadelphia, Pa. Secretary—C. S. King.

Council of American Shipbuilders, Inc. 30 Church St., New York. President—Homer L. Ferguson. Secretary-Treasurer—Henry C. Hunter.

Jersey Marine Club, 4th and River streets, Hoboken, N. J. President—Col. Bartlett.

Lake Carriers' Association. President—J. S. Ashley. Secretary—George A. Marr, Rockefeller Building, Cleveland, O.

National Association of Engine and Boat Manufacturers. 29 West 39th Street, New York City. Secretary—Ira Hand.

National Association of Masters, Mates and Pilots. National Secretary—M. D. Tennis-wood, 308 Vine St., Camden, N. J.

National Marine Engineers' Beneficial Association. Headquarters, 311-315 Machinists Building. Washington, D. C. President—Wm. F. Yates. Secretary—Albert L. Jones.

National Merchant Marine Association. Munsey Bldg., Washington, D. C. President—Hon. J. E. Ransdell.

Neptune Association. 21 Pearl St., New York City. Secretary-Treasurer—Captain John F. Milliken.

New York and New Jersey Dry Dock Association, 111 Broadway, New York. President—Jonathan Moore.

Ocean Association of Marine Engineers. 15 Whitehall St., New York. Secretary—Bert L. Todd.

Port of New York Authority. 75 West Street, New York. Chairman—George S. Silzer. Secretary—Wilson J. Vance.

Society of Naval Architects and Marine Engineers. 29 West 39th Street, New York. Secretary and Treasurer—Daniel H. Cox.

The Maritime Association of the Port of New York. 78 Broad St., New York City. President—John Dowd. Secretary—John F. Manning.

The New York Tow Boat Exchange. 11 Moore St., New York. Manager—Charles A. Mason.

The Propeller Club of the Port of New York. President—Edward A. Colson, 85 Liberty Street, New York. Secretary—William C. Gray, 17 Battery Place, New York.

United States Naval Institute. Naval Academy, Annapolis, Md. Secretary and Treasurer—Captain H. A. Baldridge, U. S. N.

United States Ship Operators' Association. 149 Broadway, New York. President—Winchester Noyes.

Canada

Grand Council N. A. of M. E. of Canada. Grand Secretary-Treasurer—W. A. MacDonald, 62 Albert St., Halifax, N. S.

Great Britain

Institute of Marine Engineers, Incorporated. 85/88 The Minories, London, E.1.

Institution of Engineers and Shipbuilders in Scotland. 39 Elmbank Crescent, Glasgow.

Institution of Naval Architects. Adelphi Terrace, London, W. C.

Northeast Coast Institution of Engineers and Shipbuilders. Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

France

Association Technique Maritime et Aéronautique. Secrétariat Général—7, rue de Madrid, Paris (8e).

Italy

Collegio Degli Ingegneri Navali e Meccanici in Italia.

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Gen. Gassouin

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That "personal equation" in welding —★

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Let us straighten out this idea once and for all. Good welders are necessary, but with proper supervision good welders can be developed in a comparatively short time. Here, for example, are test records of single vee welds made with high grade soft iron wire by an average student during the first months of his employment:

Month	No. of Welds Tested	Average Tensile Strength
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July	3	39,000
August	5	44,000
September	4	49,000
October	3	49,400

And when it is remembered that 47,000 is the average tensile strength of single vee joints with high grade soft iron wire, it can be assumed that a welder having a reasonable training period, working under proper shop conditions and competent supervision, would be able to turn out work meeting any reasonable specification.

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Vol. XXXII **No. 3**

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Marine Engineering
And Shipping Age

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Marine Engineering
and Shipping Age

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Build Ships!

THE short session of the Congress is drawing to a close, the Shipping Board has made its report on ways and means for maintaining the merchant marine—and nothing constructive has been accomplished nor does it appear in the least probable that anything will be done towards the construction of new vessels. As usual, much talk, many ideas, no action!

The Shipping Board has been provided with funds to continue as at present—all that seems likely to come of its much heralded construction program is the reconditioning of the *America*—something that any well organized private company would have attended to long ago.

The only really constructive proposal, looking towards the maintenance of the North Atlantic passenger service which the board has ever received has been rejected—there is nothing in sight to take its place. Whatever later Congresses may do it now seems certain that the United States Lines will soon find themselves where effective competition with the new foreign vessels which on every hand are rapidly taking shape will be impossible. Even though the Congress at its next regular session should provide liberally for new construction, years must elapse before replacements can be made. Long before then the United States Lines, as a competitive organization of the first rank, will be in a most difficult, if not impossible, position.

In government circles the opinion has been expressed that the recent charter and purchase proposals had the unanimous approval of the foreign steamship companies—that they were, in effect, a deep scheme to put the United States off of the Atlantic. One cannot but wonder what these same foreign companies think of the position in which the Shipping Board, with the aid of certain members of the Congress, now seems likely to find itself.

If the board could only function as well in building as it does in operating passenger ships, all would be well.

If the Congress will undertake new construction *at once,* all well and good; the question of who will operate the new ships can be settled later. The all important fact is that new vessels must be commenced *now,* if the American flag is to continue to fly over first class Atlantic ships.

No one wants an extra session of the Congress, if it can be avoided, but the shipping situation is critical. Are there not enough broad minded and far seeing men in Washington who can be brought to realize its gravity and who can be made to understand that something constructive *must* be accomplished *now,* even at the expense of an extra session?

Small Cruisers

THE chance of adding ships of real fighting value to the navy appears small at the present time. So long as there is another possible disarmament conference in the offing there is at least a plausible excuse for saving money and for retarding as much as possible the construction of ships having material combat value. To the writer, the probability that the various European powers and Japan will consent to a further material reduction of naval forces seems very remote. Eventually our fleet of modern high speed cruisers will undoubtedly be increased but, for the present, paper ships seem likely to replace steel ones, as far as our navy is concerned.

There is another class of vessel, however, for which, to the layman at least, our navy appears to have a real need—small cruisers. Whether we like it or not, this country has to maintain police duty in Central American waters, and present indications are that this service will have to be maintained for years to come. Large ships have no place here and the new scouts are in every sense large ships, far too costly and expensive to run and also too unhandy for most police duty. Practically the only peace-time cruisers which we have are the ships of the *Denver* class, now 25 years old and presumably pretty well worn out. Moreover they are of 3,000 tons displacement, too large for much of the work alluded to. A gunboat or sloop of say 1,500 tons can do this work more handily and very much more cheaply.

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Naturally the navy wishes to invest such funds as it can obtain from the Congress in effective fighting ships but as these for the present at least are "taboo," could not attention be turned, with advantage, to smaller but very useful vessels with which disarmament propagandists can in no way be concerned?

High Pressure Steam

THE position of the editor of a technical paper has its own difficulties and often is far from being an enviable one. If he is in any degree fair minded and if his paper is to be kept from becoming merely a disbursing medium for various forms of advertising propaganda, his first and paramount duty is to place before his readers all sides of any controversial matter; to give, so far as he is able, all dominant aspects of every subject, divorcing from his editorials his own personal prejudices and eliminating from the discussion his own feelings as regards the personality of the disputants or the merits of their respective cases. On the other hand, the editor, if he has a fair knowledge of the industry which his paper represents, and it is to be presumed that every editor of a technical or semi-technical publication has this knowledge, should be quite capable of forming his own opinion as to the merits of any matter. Once this opinion is formed it is his right and his duty to express it, taking particular care, however, to make clear the foundations upon which his opinion is based.

In every branch of engineering there are many controversial subjects and in practically every instance reasonable arguments may be made on each side of every question which arises. Competition often leads to exaggeration and misstatement of facts and these again are to be found on each side of almost every argument. Each competitor naturally likes to feel that his position is unassailable and too often comes to look upon as questionable any statement commending in the slightest degree the arguments of his opponents. It is the editor's business to get at *all* the facts and present them as clearly as he may, however much he may be accused of "going over to the enemy" or of "carrying water on both shoulders." To the latter accusation he must often plead guilty, for every argument must, in the nature of things, have two sides and it is "up to him" to give due credit to both of them.

The contest between steam and internal combustion engines, now so sharply drawn, is one bristling with difficulties when the attempt is made to draw a fair and unbiased conclusion as to the respective merits of the two forms of prime mover. On the one hand, the Diesel enthusiast would have his audience believe that "all is over but the shouting;" that the steam engine is dead although as yet not fully aware of the fact. On the other hand, the dyed-in-the-wool steam engineer will shake his head and hint darkly of the multitudinous and closely concealed troubles incident to the operation of motorships, their great cost and the rising price of oil fuel. In reality each is stating what he *hopes,* not what he *knows* and each, if he is a real engineer, has, deep down in his heart, a wholesome respect for certain parts, at least, of his opponents' argument although he is most careful not to mention these things himself and is prone to be resentful if anyone else does so. In engineering the "truth" may often have cause to be changed and modified to keep abreast of progress but usually it is to be found somewhere between the limits, pro and con, of all discussions. Thus, on the one hand, the ever increasing number of motorships and the fact that many new vessels of this class are being built for owners already operating motorships casts at least a very reasonable doubt upon reported difficulties of operation, while on the other, the very high efficiency of the modern power house and the relatively low cost of its driving machinery make it seem probable that here, at least, steam is strongly entrenched for many years to come. It cannot be reasonably expected that either form of motive power will be used exclusively for all purposes and under all conditions of operation.

In one respect the marine steam engineer is under obligation to the Diesel. While steam pressures have been increasing and economy has improved, the marine steam plant has, for what appear to be good and sufficient reasons, lagged behind its shore prototype in the matter of thermodynamic efficiency, and it is to the advent of the Diesel and the very great popularity which it has attained in such a short time that the present attempts to improve the marine steam plant are mainly due—the steam engineer has been fully awakened to the fact that if his engine is long to continue in service it must be radically modified and improved.

Elsewhere in this issue there will be found a paper recently read by Sir Charles A. Parsons, the inventor of the steam turbine, before the North East Coast Institution of Engineers and Shipbuilders. This paper is of great interest in its outline of the development of the marine steam turbine; it is of outstanding importance in that it makes public, for the first time, the performance results of the high pressure steamer *King George V,* a vessel which, if the hopes of her designers and builders are entirely fulfilled, marks an epoch in marine engineering. It is very true that "one swallow does not make a summer,"—experience with more than one vessel will be necessary to prove or disprove the value of very high steam pressures and temperatures on shipboard but a beginning has been made and its results are impressive.

At full power the *King George V* consumed 1.085 pounds of ordinary quality coal per shaft horsepower hour. The total shaft power developed was 3,489 and the coal consumed per hour 3,785 pounds. At the present New York rate for bunker coal ($5.80 per ton) this coal would cost $9.04. Now assume a Diesel installation of the same power, consuming approximately 0.42 pound of oil per shaft horsepower hour. The total fuel consumed per hour would be 1,465 pounds and its cost at the present price of Diesel oil at the refiner's pier in New York ($2.40 per barrel) would be $11.40. On the surface it seems apparent that the steamer has a considerable advantage, so far as fuel costs are concerned, at the present time but it must be remembered that the price of neither coal nor oil is

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a fixed quantity and is liable to fluctuations and that a comparatively small change in the relative price of the two fuels would present a quite different picture.

The performance of the *King George V* is a remarkable one, from the marine standpoint, but nothing more than might have been expected by the power plant engineer. Thermodynamic efficiency is, however, but a part of the marine engineer's problem. Reliability and cost of upkeep must, particularly for a commercial, seagoing vessel, be proved satisfactory beyond reasonable doubt before fuel economy can be given equal consideration. All this will take varied experience—and time. Meanwhile the steam engineer has issued a direct challenge to the Diesel. That it will be accepted there can be not the slightest doubt, for the Diesel, in certain trades at least, is pretty evidently here to stay. The ensuing contest will be of consuming interest to the shipowner who, in the final analysis, must pay the bills.

Wear in Diesel Engines

IN a previous article mention was made of certain of the causes of wear and deterioration in marine steam machinery. It is now proposed to consider in a very general way those features of operation which are likely to cause wear in and which, in the main, are confined to the internal combustion engine.

From the fundamental principles upon which it is based —the extremes of both temperature and pressure involved in its cycle of operation—the Diesel lays upon all of its parts and the materials of which they are formed the most trying conditions, particularly in view of the tendency to measure these conditions from the point of view of the steam engineer. The great and sudden variations of pressure call for particular attention to bearings and their efficient lubrication while equally great variations in cylinder temperatures make the form of the cylinder walls and heads and the materials entering into their construction of particular concern. These are, however, matters of fundamental design rather than of operation; problems which are being successfully dealt with, if not yet entirely solved.

Turning to the more practical side of the question, it appears that the principal cause of operating difficulties and wear in the Diesel has a somewhat similar origin to that which rises up to plague its steam-driven predecessor, for while the latter may be brought to grief by the impurities contained in the water supplied to its boilers, the former's difficulties come chiefly from impurities in the fuel fed to its cylinders. In both cases the seat of difficulty and particularly of undue wear and wastage is in the fluid which supplies the driving force.

Probably the presence of sulphur in the fuel oil is the principal cause of undue wear in the Diesel cylinder and the valves connecting with it. This seems to be particularly true with the exhaust valves of four-cycle engines and tends to prevent the use of the heavier and less highly refined fuels in these engines. Following this line of reasoning the two-cycle engine with exhaust ports in the cylinder barrel is put forward as particularly suitable for the use of heavy oil. As a matter of fact both types of engine are liable to damage from the cause mentioned for it appears that the most damage is done not while the engine is running, but when it is standing still and the acids formed have the opportunity of acting upon cylinder walls and piston as well as upon the valves in the cylinder head. It is this fact which has led to the practice, on the part of some operating engineers, of cutting off the regular fuel supply shortly before shutting down their engines and running the latter on kerosene or some similar high grade oil for a sufficient period to clear out all impurities and leave the various surfaces coated with a substance not actively corrosive. When this practice is followed it appears that the heavier types of fuel, at least so far as their sulphur content is concerned, are not particularly harmful to either two- or four-cycle engines.

Aside from their acid-producing constituents, all fuel oils contain in greater or less quantity non-combustible substances leaving, after burning, an ash closely akin to that resulting from the burning of coal and often of a highly abrasive character. Naturally this is more in evidence in heavy than in lighter and more highly refined oils but it is always present in some degree, together with other impurities. Recently the writer visited a very fine British motorship fitted with twin screw two-cycle engines and found to his surprise that although a so-called "Diesel oil" of about 22 degrees Beaumé was used it was all being thoroughly centrifuged before feeding to the engines. Furthermore the chief engineer exhibited a quantity of thick, black paste taken from the fuel with the remark that it could be used to "polish brass." If such a substance can be found in a refined oil, the use of the heavier and presumably more contaminated fuels, without some preparatory cleansing treatment, seems a doubtful economy. Undoubtedly the heavier oils are cheaper but cylinder liners and valves are expensive and a very considerable saving must be realized from the use of cheap oil, if expensive replacements and delays are to be fully offset. In any event the very great value and importance of the centrifugal or other efficient oil separator seem to be well established by such experiences as that mentioned.

Another source of impurities in the Diesel cylinder, not so pronounced as the fuel but nevertheless a possible cause of trouble, lies in the air entering the air intakes of four-cycle engines or the scavenging air inlets of two-cycle engines. To realize the truth of this statement one has but to run his hand over the air inlets to cylinder, air compressor or scavenging pump to find in many if not most cases a surprising amount of dust and dirt. While a considerable portion is deflected by the slots of the intakes it is apparent that much foreign matter must in this manner find its way into the cylinders or pumps and if this dust happens to be of an abrasive character its eventual effect can hardly fail to be harmful. Possibly the damage resulting from the presence of dust in the air taken in by engines and compressors aboardship is not of sufficient importance to warrant the fitting of an air filter but in this connection it is worthy of note that filters are being fitted to the carburetter air intakes on motor cars where the dust conditions are obviously of serious moment.

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forged tools. It thoroughly covers wrenches of all types, eye bolts, chisels, clamps, dogs, ends, extensions, hammers, tool kits, nuts, pliers, punches, ratchets, screw drivers, thumb screws, sets, sleeves, sockets, cotter pin tools, etc. Anyone mentioning this magazine can secure a copy free of cost.

Haskelite and Plymetl.—The third issue of "The Light Weight Champions' Record" which is the house organ of the Haskelite Manufacturing Company, Chicago, manufacturers of Haskelite and Plymetl, has recently been issued. This bulletin is devoted to a description of the uses to which Haskelite and Plymetl are being put in various industries. It contains a special article by James Raymond Fitzpatrick, C. E., secretary and director of sales, on "Building New Markets for Haskelite, War-Born Industrial Product." This article, which was reprinted from the January issue of "Industrial Marketing," deals with a number of applications of this material, including its uses aboard ship, where it makes a satisfactory bulkhead material for separating staterooms in passenger vessels, and has been used largely in new ship construction and reconditioning work by Atlantic coast and Great Lakes shipyards. A number of notable installations are mentioned including the liners *Leviathan, George Washington* and other United States Lines vessels; the Lake liners *City of Detroit* and *City of Cleveland, III* as well as in the Merchants and Miners and Norfolk and Washington boats. On the west coast, the latest vessels which have adopted Haskelite and Plymetl are the ferryboats for the Key System and the new vessels of the Los Angeles Steamship Company. On the new car ferry *Madison* for the Grand Trunk Railway System, now nearing completion, both Haskelite and Plymetl have been used extensively; on the former for bulkheads, interior side linings, ceilings, etc. and on the latter for exterior doors.

BUSINESS NOTES

L. H. Coolidge and H. C. Hanson, Seattle, Wash., naval architects, have formed a partnership with offices at 117 Grand Trunk dock.

William Z. Gardner, former president of the Propeller Club of the Port of New York, is now located at 136 Liberty street, New York, where he plans to handle advertising and marine publicity work.

Alexander McNab, president of the McNab Company, formerly of Bridgeport, Conn., is now located at No. 1 Broadway, New York. All correspondence regarding McNab marine inventions and auxiliaries should be forwarded to the new address.

The Air Reduction Company, Inc., has acquired, through a long-term lease from the Commercial Acetylene Supply Company, Inc., the plants and business of that company on the Pacific coast. The two acetylene manufacturing plants are located at Berkeley and Los Angeles, Cal., respectively.

George Solz, Jr., has been appointed by the Bridgeport Brass Company, Bridgeport, Conn., to sell their line of tubular plumbing supplies, brass pipe and fittings in Northern New Jersey and the Bridgeport-Keating flush valve in the entire state of New Jersey and Rockland County, New York.

Theodore Beran of New York, H. L. Monroe of Chicago and J. A. Cranston of San Francisco have been appointed commercial vice presidents of the General Electric Company, Schenectady, New York, in charge of the commercial activities of the company in the New York, central, and Pacific coast districts, respectively. E. W. Allen, manager of engineering, was elected vice president in charge of engineering with offices in Schenectady.

Anson Wood Burchard, vice-chairman of the board of directors and chairman of the executive committee of the General Electric Company and chairman of the board of directors of the International General Electric Company, died on January 22 of acute indigestion in New York City. He was 61 years old and was director of several utility and electrical companies and a member of many electrical and power clubs and organizations.

Harry E. Miller has been appointed works manager of the Newark, N. J., plant of the Westinghouse Electric and Manufacturing Company. Mr. Miller entered the employ of the Westinghouse Company at Pittsburgh in 1889 and was assigned to the machine and tool departments and later moved to the erection and test sections. Eleven years later he was transferred to the Newark factory as foreman of the inspection and tests of ampere and watthour meters and fan motors. Mr. Miller continued as an executive of the Newark plant, becoming successively assistant superintendent, superintendent, assistant works manager and finally manager.

James A. Davies, assistant general superintendent of the South Philadelphia Works, Westinghouse Electric and Manufacturing Company, for the past eight years, has been appointed general superintendent to fill the position made vacant by the death of Mr. H. M. Giles, widely known in engineering circles throughout the United States. Alfred Voysey was appointed to the position of assistant general superintendent formerly held by Mr. Davies and James Lyons was promoted to the position of supervising production department vacated by Mr. Voysey.

The American Brass Company announces that arrangements have been completed whereby it will take over the manufacture and sale of Everdur Metal from the Du Pont Everdur Company. Everdur is a trademarked and patented alloy of copper, silicon and manganese. It was developed by the Du Pont Company in their search for a metal that would combine the tensile strength and elastic limit of low and medium carbon steels with good machining and working qualities and high resistance to a large number of corroding agents. This alloy is manufactured by the American Brass Company in the form of casting ingots, plates, sheets, rods and wire, and is also available in the form of washers, bolts, nuts, screws, rivets, wire cloth and castings. It casts readily, can be drop forged, stamped and pressed. The research work conducted by the Du Pont Everdur Company in developing Everdur Metal will be continued by the American Brass Company in the further development of this material for various purposes in their laboratories.

Marine Societies

America

American Marine Association. 30 Church St., New York. President—Col. E. A. Simmons.

American Marine Standards Committee. Chairman, Colonel E. A. Simmons. Secretary, A. V. Bouillon, Division of Simplified Practice, Department of Commerce, Washington, D. C.

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American Society of Marine Engineers. 605 Market St., San Francisco, Calif. President—Benjamin S. Free. Secretary—Wm. H. Thille.

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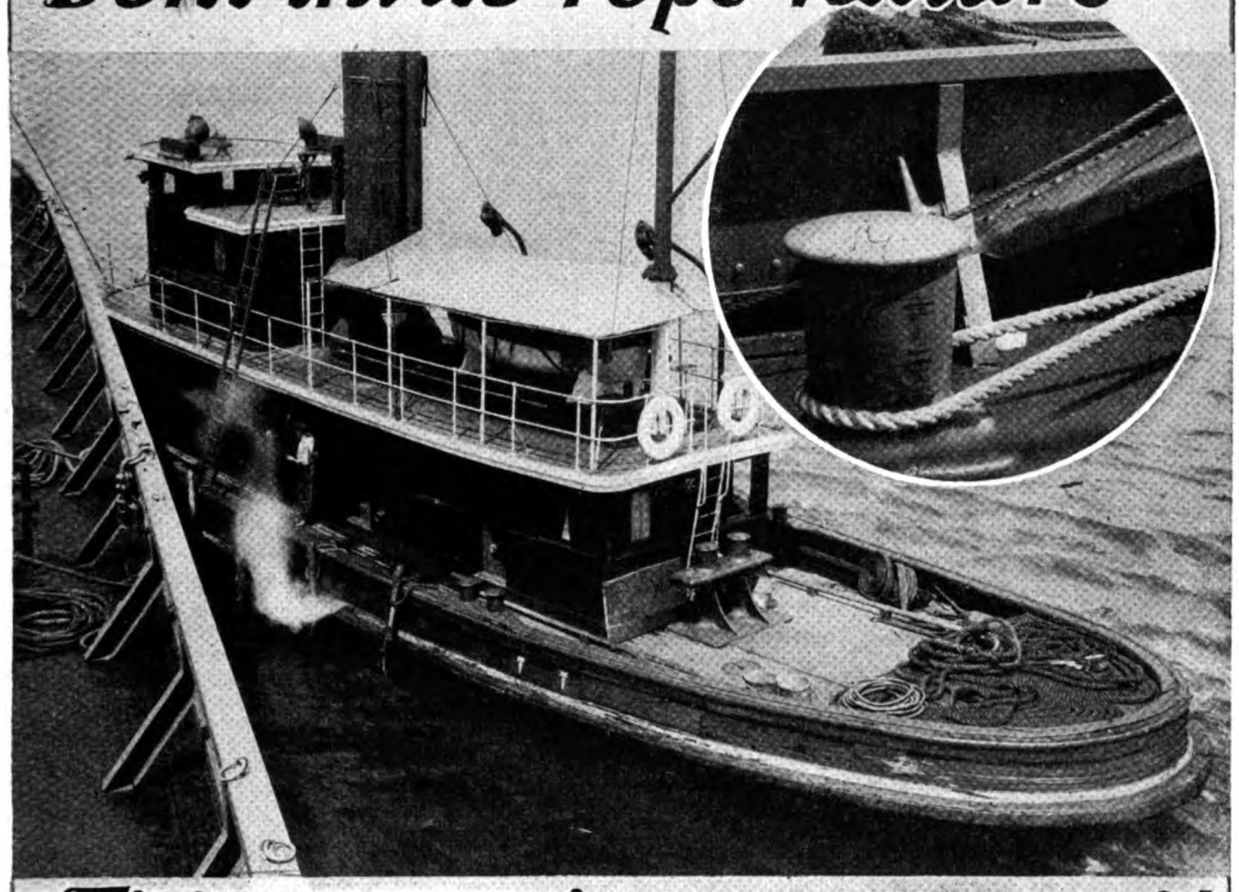

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Build Ships!

THE short session of the Congress is drawing to a close, the Shipping Board has made its report on ways and means for maintaining the merchant marine—and nothing constructive has been accomplished nor does it appear in the least probable that anything will be done towards the construction of new vessels. As usual, much talk, many ideas, no action!

The Shipping Board has been provided with funds to continue as at present—all that seems likely to come of its much heralded construction program is the reconditioning of the *America*—something that any well organized private company would have attended to long ago.

The only really constructive proposal, looking towards the maintenance of the North Atlantic passenger service which the board has ever received has been rejected—there is nothing in sight to take its place. Whatever later Congresses may do it now seems certain that the United States Lines will soon find themselves where effective competition with the new foreign vessels which on every hand are rapidly taking shape will be impossible. Even though the Congress at its next regular session should provide liberally for new construction, years must elapse before replacements can be made. Long before then the United States Lines, as a competitive organization of the first rank, will be in a most difficult, if not impossible, position.

In government circles the opinion has been expressed that the recent charter and purchase proposals had the unanimous approval of the foreign steamship companies—that they were, in effect, a deep scheme to put the United States off of the Atlantic. One cannot but wonder what these same foreign companies think of the position in which the Shipping Board, with the aid of certain members of the Congress, now seems likely to find itself.

If the board could only function as well in building as it does in operating passenger ships, all would be well.

If the Congress will undertake new construction *at once*, all well and good; the question of who will operate the new ships can be settled later. The all important fact is that new vessels must be commenced *now*, if the American flag is to continue to fly over first class Atlantic ships.

No one wants an extra session of the Congress, if it can be avoided, but the shipping situation is critical. Are there not enough broad minded and far seeing men in Washington who can be brought to realize its gravity and who can be made to understand that something constructive *must* be accomplished *now*, even at the expense of an extra session?

Small Cruisers

THE chance of adding ships of real fighting value to the navy appears small at the present time. So long as there is another possible disarmament conference in the offing there is at least a plausible excuse for saving money and for retarding as much as possible the construction of ships having material combat value. To the writer, the probability that the various European powers and Japan will consent to a further material reduction of naval forces seems very remote. Eventually our fleet of modern high speed cruisers will undoubtedly be increased but, for the present, paper ships seem likely to replace steel ones, as far as our navy is concerned.

There is another class of vessel, however, for which, to the layman at least, our navy appears to have a real need—small cruisers. Whether we like it or not, this country has to maintain police duty in Central American waters, and present indications are that this service will have to be maintained for years to come. Large ships have no place here and the new scouts are in every sense large ships, far too costly and expensive to run and also too unhandy for most police duty. Practically the only peace-time cruisers which we have are the ships of the *Denver* class, now 25 years old and presumably pretty well worn out. Moreover they are of 3,000 tons displacement, too large for much of the work alluded to. A gunboat or sloop of say 1,500 tons can do this work more handily and very much more cheaply.

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Naturally the navy wishes to invest such funds as it can obtain from the Congress in effective fighting ships but as these for the present at least are "taboo," could not attention be turned, with advantage, to smaller but very useful vessels with which disarmament propagandists can in no way be concerned?

High Pressure Steam

THE position of the editor of a technical paper has its own difficulties and often is far from being an enviable one. If he is in any degree fair minded and if his paper is to be kept from becoming merely a disbursing medium for various forms of advertising propaganda, his first and paramount duty is to place before his readers all sides of any controversial matter; to give, so far as he is able, all dominant aspects of every subject, divorcing from his editorials his own personal prejudices and eliminating from the discussion his own feelings as regards the personality of the disputants or the merits of their respective cases. On the other hand, the editor, if he has a fair knowledge of the industry which his paper represents, and it is to be presumed that every editor of a technical or semi-technical publication has this knowledge, should be quite capable of forming his own opinion as to the merits of any matter. Once this opinion is formed it is his right and his duty to express it, taking particular care, however, to make clear the foundations upon which his opinion is based.

In every branch of engineering there are many controversial subjects and in practically every instance reasonable arguments may be made on each side of every question which arises. Competition often leads to exaggeration and misstatement of facts and these again are to be found on each side of almost every argument. Each competitor naturally likes to feel that his position is unassailable and too often comes to look upon as questionable any statement commending in the slightest degree the arguments of his opponents. It is the editor's business to get at *all* the facts and present them as clearly as he may, however much he may be accused of "going over to the enemy" or of "carrying water on both shoulders." To the latter accusation he must often plead guilty, for every argument must, in the nature of things, have two sides and it is "up to him" to give due credit to both of them.

The contest between steam and internal combustion engines, now so sharply drawn, is one bristling with difficulties when the attempt is made to draw a fair and unbiased conclusion as to the respective merits of the two forms of prime mover. On the one hand, the Diesel enthusiast would have his audience believe that "all is over but the shouting;" that the steam engine is dead although as yet not fully aware of the fact. On the other hand, the dyed-in-the-wool steam engineer will shake his head and hint darkly of the multitudinous and closely concealed troubles incident to the operation of motorships, their great cost and the rising price of oil fuel. In reality each is stating what he *hopes*, not what he *knows* and each, if he is a real engineer, has, deep down in his heart, a wholesome respect for certain parts, at least, of his opponents' argument although he is most careful not to mention these things himself and is prone to be resentful if anyone else does so. In engineering the "truth" may often have cause to be changed and modified to keep abreast of progress but usually it is to be found somewhere between the limits, pro and con, of all discussions. Thus, on the one hand, the ever increasing number of motorships and the fact that many new vessels of this class are being built for owners already operating motorships casts at least a very reasonable doubt upon reported difficulties of operation, while on the other, the very high efficiency of the modern power house and the relatively low cost of its driving machinery make it seem probable that here, at least, steam is strongly entrenched for many years to come. It cannot be reasonably expected that either form of motive power will be used exclusively for all purposes and under all conditions of operation.

In one respect the marine steam engineer is under obligation to the Diesel. While steam pressures have been increasing and economy has improved, the marine steam plant has, for what appear to be good and sufficient reasons, lagged behind its shore prototype in the matter of thermodynamic efficiency, and it is to the advent of the Diesel and the very great popularity which it has attained in such a short time that the present attempts to improve the marine steam plant are mainly due—the steam engineer has been fully awakened to the fact that if his engine is long to continue in service it must be radically modified and improved.

Elsewhere in this issue there will be found a paper recently read by Sir Charles A. Parsons, the inventor of the steam turbine, before the North East Coast Institution of Engineers and Shipbuilders. This paper is of great interest in its outline of the development of the marine steam turbine; it is of outstanding importance in that it makes public, for the first time, the performance results of the high pressure steamer *King George V*, a vessel which, if the hopes of her designers and builders are entirely fulfilled, marks an epoch in marine engineering. It is very true that "one swallow does not make a summer,"—experience with more than one vessel will be necessary to prove or disprove the value of very high steam pressures and temperatures on shipboard but a beginning has been made and its results are impressive.

At full power the *King George V* consumed 1.085 pounds of ordinary quality coal per shaft horsepower hour. The total shaft power developed was 3,489 and the coal consumed per hour 3,785 pounds. At the present New York rate for bunker coal ($5.80 per ton) this coal would cost $9.04. Now assume a Diesel installation of the same power, consuming approximately 0.42 pound of oil per shaft horsepower hour. The total fuel consumed per hour would be 1,465 pounds and its cost at the present price of Diesel oil at the refiner's pier in New York ($2.40 per barrel) would be $11.40. On the surface it seems apparent that the steamer has a considerable advantage, so far as fuel costs are concerned, at the present time but it must be remembered that the price of neither coal nor oil is

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a fixed quantity and is liable to fluctuations and that a comparatively small change in the relative price of the two fuels would present a quite different picture.

The performance of the *King George V* is a remarkable one, from the marine standpoint, but nothing more than might have been expected by the power plant engineer. Thermodynamic efficiency is, however, but a part of the marine engineer's problem. Reliability and cost of upkeep must, particularly for a commercial, seagoing vessel, be proved satisfactory beyond reasonable doubt before fuel economy can be given equal consideration. All this will take varied experience—and time. Meanwhile the steam engineer has issued a direct challenge to the Diesel. That it will be accepted there can be not the slightest doubt, for the Diesel, in certain trades at least, is pretty evidently here to stay. The ensuing contest will be of consuming interest to the shipowner who, in the final analysis, must pay the bills.

Wear in Diesel Engines

IN a previous article mention was made of certain of the causes of wear and deterioration in marine steam machinery. It is now proposed to consider in a very general way those features of operation which are likely to cause wear in and which, in the main, are confined to the internal combustion engine.

From the fundamental principles upon which it is based —the extremes of both temperature and pressure involved in its cycle of operation—the Diesel lays upon all of its parts and the materials of which they are formed the most trying conditions, particularly in view of the tendency to measure these conditions from the point of view of the steam engineer. The great and sudden variations of pressure call for particular attention to bearings and their efficient lubrication while equally great variations in cylinder temperatures make the form of the cylinder walls and heads and the materials entering into their construction of particular concern. These are, however, matters of fundamental design rather than of operation; problems which are being successfully dealt with, if not yet entirely solved.

Turning to the more practical side of the question, it appears that the principal cause of operating difficulties and wear in the Diesel has a somewhat similar origin to that which rises up to plague its steam-driven predecessor, for while the latter may be brought to grief by the impurities contained in the water supplied to its boilers, the former's difficulties come chiefly from impurities in the fuel fed to its cylinders. In both cases the seat of difficulty and particularly of undue wear and wastage is in the fluid which supplies the driving force.

Probably the presence of sulphur in the fuel oil is the principal cause of undue wear in the Diesel cylinder and the valves connecting with it. This seems to be particularly true with the exhaust valves of four-cycle engines and tends to prevent the use of the heavier and less highly refined fuels in these engines. Following this line of reasoning the two-cycle engine with exhaust ports in the cylinder barrel is put forward as particularly suitable for the use of heavy oil. As a matter of fact both types of engine are liable to damage from the cause mentioned for it appears that the most damage is done not while the engine is running, but when it is standing still and the acids formed have the opportunity of acting upon cylinder walls and piston as well as upon the valves in the cylinder head. It is this fact which has led to the practice, on the part of some operating engineers, of cutting off the regular fuel supply shortly before shutting down their engines and running the latter on kerosene or some similar high grade oil for a sufficient period to clear out all impurities and leave the various surfaces coated with a substance not actively corrosive. When this practice is followed it appears that the heavier types of fuel, at least so far as their sulphur content is concerned, are not particularly harmful to either two- or four-cycle engines.

Aside from their acid-producing constituents, all fuel oils contain in greater or less quantity non-combustible substances leaving, after burning, an ash closely akin to that resulting from the burning of coal and often of a highly abrasive character. Naturally this is more in evidence in heavy than in lighter and more highly refined oils but it is always present in some degree, together with other impurities. Recently the writer visited a very fine British motorship fitted with twin screw two-cycle engines and found to his surprise that although a so-called "Diesel oil" of about 22 degrees Beaumé was used it was all being thoroughly centrifuged before feeding to the engines. Furthermore the chief engineer exhibited a quantity of thick, black paste taken from the fuel with the remark that it could be used to "polish brass." If such a substance can be found in a refined oil, the use of the heavier and presumably more contaminated fuels, without some preparatory cleansing treatment, seems a doubtful economy. Undoubtedly the heavier oils are cheaper but cylinder liners and valves are expensive and a very considerable saving must be realized from the use of cheap oil, if expensive replacements and delays are to be fully offset. In any event the very great value and importance of the centrifugal or other efficient oil separator seem to be well established by such experiences as that mentioned.

Another source of impurities in the Diesel cylinder, not so pronounced as the fuel but nevertheless a possible cause of trouble, lies in the air entering the air intakes of four-cycle engines or the scavenging air inlets of two-cycle engines. To realize the truth of this statement one has but to run his hand over the air inlets to cylinder, air compressor or scavenging pump to find in many if not most cases a surprising amount of dust and dirt. While a considerable portion is deflected by the slots of the intakes it is apparent that much foreign matter must in this manner find its way into the cylinders or pumps and if this dust happens to be of an abrasive character its eventual effect can hardly fail to be harmful. Possibly the damage resulting from the presence of dust in the air taken in by engines and compressors aboardship is not of sufficient importance to warrant the fitting of an air filter but in this connection it is worthy of note that filters are being fitted to the carburetter air intakes on motor cars where the dust conditions are obviously of serious moment.

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Naturally the navy wishes to invest such funds as it can obtain from the Congress in effective fighting ships but as these for the present at least are "taboo," could not attention be turned, with advantage, to smaller but very useful vessels with which disarmament propagandists can in no way be concerned?

High Pressure Steam

THE position of the editor of a technical paper has its own difficulties and often is far from being an enviable one. If he is in any degree fair minded and if his paper is to be kept from becoming merely a disbursing medium for various forms of advertising propaganda, his first and paramount duty is to place before his readers all sides of any controversial matter; to give, so far as he is able, all dominant aspects of every subject, divorcing from his editorials his own personal prejudices and eliminating from the discussion his own feelings as regards the personality of the disputants or the merits of their respective cases. On the other hand, the editor, if he has a fair knowledge of the industry which his paper represents, and it is to be presumed that every editor of a technical or semi-technical publication has this knowledge, should be quite capable of forming his own opinion as to the merits of any matter. Once this opinion is formed it is his right and his duty to express it, taking particular care, however, to make clear the foundations upon which his opinion is based.

In every branch of engineering there are many controversial subjects and in practically every instance reasonable arguments may be made on each side of every question which arises. Competition often leads to exaggeration and misstatement of facts and these again are to be found on each side of almost every argument. Each competitor naturally likes to feel that his position is unassailable and too often comes to look upon as questionable any statement commending in the slightest degree the arguments of his opponents. It is the editor's business to get at *all* the facts and present them as clearly as he may, however much he may be accused of "going over to the enemy" or of "carrying water on both shoulders." To the latter accusation he must often plead guilty, for every argument must, in the nature of things, have two sides and it is "up to him" to give due credit to both of them.

The contest between steam and internal combustion engines, now so sharply drawn, is one bristling with difficulties when the attempt is made to draw a fair and unbiased conclusion as to the respective merits of the two forms of prime mover. On the one hand, the Diesel enthusiast would have his audience believe that "all is over but the shouting;" that the steam engine is dead although as yet not fully aware of the fact. On the other hand, the dyed-in-the-wool steam engineer will shake his head and hint darkly of the multitudinous and closely concealed troubles incident to the operation of motorships, their great cost and the rising price of oil fuel. In reality each is stating what he *hopes,* not what he *knows* and each, if he is a real engineer, has, deep down in his heart, a wholesome respect for certain parts, at least, of his opponents' argument although he is most careful not to mention these things himself and is prone to be resentful if anyone else does so. In engineering the "truth" may often have cause to be changed and modified to keep abreast of progress but usually it is to be found somewhere between the limits, pro and con, of all discussions. Thus, on the one hand, the ever increasing number of motorships and the fact that many new vessels of this class are being built for owners already operating motorships casts at least a very reasonable doubt upon reported difficulties of operation, while on the other, the very high efficiency of the modern power house and the relatively low cost of its driving machinery make it seem probable that here, at least, steam is strongly entrenched for many years to come. It cannot be reasonably expected that either form of motive power will be used exclusively for all purposes and under all conditions of operation.

In one respect the marine steam engineer is under obligation to the Diesel. While steam pressures have been increasing and economy has improved, the marine steam plant has, for what appear to be good and sufficient reasons, lagged behind its shore prototype in the matter of thermodynamic efficiency, and it is to the advent of the Diesel and the very great popularity which it has attained in such a short time that the present attempts to improve the marine steam plant are mainly due—the steam engineer has been fully awakened to the fact that if his engine is long to continue in service it must be radically modified and improved.

Elsewhere in this issue there will be found a paper recently read by Sir Charles A. Parsons, the inventor of the steam turbine, before the North East Coast Institution of Engineers and Shipbuilders. This paper is of great interest in its outline of the development of the marine steam turbine; it is of outstanding importance in that it makes public, for the first time, the performance results of the high pressure steamer *King George V,* a vessel which, if the hopes of her designers and builders are entirely fulfilled, marks an epoch in marine engineering. It is very true that "one swallow does not make a summer,"—experience with more than one vessel will be necessary to prove or disprove the value of very high steam pressures and temperatures on shipboard but a beginning has been made and its results are impressive.

At full power the *King George V* consumed 1.085 pounds of ordinary quality coal per shaft horsepower hour. The total shaft power developed was 3,489 and the coal consumed per hour 3,785 pounds. At the present New York rate for bunker coal ($5.80 per ton) this coal would cost $9.04. Now assume a Diesel installation of the same power, consuming approximately 0.42 pound of oil per shaft horsepower hour. The total fuel consumed per hour would be 1,465 pounds and its cost at the present price of Diesel oil at the refiner's pier in New York ($2.40 per barrel) would be $11.40. On the surface it seems apparent that the steamer has a considerable advantage, so far as fuel costs are concerned, at the present time but it must be remembered that the price of neither coal nor oil is

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a fixed quantity and is liable to fluctuations and that a comparatively small change in the relative price of the two fuels would present a quite different picture.

The performance of the *King George V* is a remarkable one, from the marine standpoint, but nothing more than might have been expected by the power plant engineer. Thermodynamic efficiency is, however, but a part of the marine engineer's problem. Reliability and cost of upkeep must, particularly for a commercial, seagoing vessel, be proved satisfactory beyond reasonable doubt before fuel economy can be given equal consideration. All this will take varied experience—and time. Meanwhile the steam engineer has issued a direct challenge to the Diesel. That it will be accepted there can be not the slightest doubt, for the Diesel, in certain trades at least, is pretty evidently here to stay. The ensuing contest will be of consuming interest to the shipowner who, in the final analysis, must pay the bills.

Wear in Diesel Engines

IN a previous article mention was made of certain of the causes of wear and deterioration in marine steam machinery. It is now proposed to consider in a very general way those features of operation which are likely to cause wear in and which, in the main, are confined to the internal combustion engine.

From the fundamental principles upon which it is based —the extremes of both temperature and pressure involved in its cycle of operation—the Diesel lays upon all of its parts and the materials of which they are formed the most trying conditions, particularly in view of the tendency to measure these conditions from the point of view of the steam engineer. The great and sudden variations of pressure call for particular attention to bearings and their efficient lubrication while equally great variations in cylinder temperatures make the form of the cylinder walls and heads and the materials entering into their construction of particular concern. These are, however, matters of fundamental design rather than of operation; problems which are being successfully dealt with, if not yet entirely solved.

Turning to the more practical side of the question, it appears that the principal cause of operating difficulties and wear in the Diesel has a somewhat similar origin to that which rises up to plague its steam-driven predecessor, for while the latter may be brought to grief by the impurities contained in the water supplied to its boilers, the former's difficulties come chiefly from impurities in the fuel fed to its cylinders. In both cases the seat of difficulty and particularly of undue wear and wastage is in the fluid which supplies the driving force.

Probably the presence of sulphur in the fuel oil is the principal cause of undue wear in the Diesel cylinder and the valves connecting with it. This seems to be particularly true with the exhaust valves of four-cycle engines and tends to prevent the use of the heavier and less highly refined fuels in these engines. Following this line of reasoning the two-cycle engine with exhaust ports in the cylinder barrel is put forward as particularly suitable for the use of heavy oil. As a matter of fact both types of engine are liable to damage from the cause mentioned for it appears that the most damage is done not while the engine is running, but when it is standing still and the acids formed have the opportunity of acting upon cylinder walls and piston as well as upon the valves in the cylinder head. It is this fact which has led to the practice, on the part of some operating engineers, of cutting off the regular fuel supply shortly before shutting down their engines and running the latter on kerosene or some similar high grade oil for a sufficient period to clear out all impurities and leave the various surfaces coated with a substance not actively corrosive. When this practice is followed it appears that the heavier types of fuel, at least so far as their sulphur content is concerned, are not particularly harmful to either two- or four-cycle engines.

Aside from their acid-producing constituents, all fuel oils contain in greater or less quantity non-combustible substances leaving, after burning, an ash closely akin to that resulting from the burning of coal and often of a highly abrasive character. Naturally this is more in evidence in heavy than in lighter and more highly refined oils but it is always present in some degree, together with other impurities. Recently the writer visited a very fine British motorship fitted with twin screw two-cycle engines and found to his surprise that although a so-called "Diesel oil" of about 22 degrees Beaumé was used it was all being thoroughly centrifuged before feeding to the engines. Furthermore the chief engineer exhibited a quantity of thick, black paste taken from the fuel with the remark that it could be used to "polish brass." If such a substance can be found in a refined oil, the use of the heavier and presumably more contaminated fuels, without some preparatory cleansing treatment, seems a doubtful economy. Undoubtedly the heavier oils are cheaper but cylinder liners and valves are expensive and a very considerable saving must be realized from the use of cheap oil, if expensive replacements and delays are to be fully offset. In any event the very great value and importance of the centrifugal or other efficient oil separator seem to be well established by such experiences as that mentioned.

Another source of impurities in the Diesel cylinder, not so pronounced as the fuel but nevertheless a possible cause of trouble, lies in the air entering the air intakes of four-cycle engines or the scavenging air inlets of two-cycle engines. To realize the truth of this statement one has but to run his hand over the air inlets to cylinder, air compressor or scavenging pump to find in many if not most cases a surprising amount of dust and dirt. While a considerable portion is deflected by the slots of the intakes it is apparent that much foreign matter must in this manner find its way into the cylinders or pumps and if this dust happens to be of an abrasive character its eventual effect can hardly fail to be harmful. Possibly the damage resulting from the presence of dust in the air taken in by engines and compressors aboardship is not of sufficient importance to warrant the fitting of an air filter but in this connection it is worthy of note that filters are being fitted to the carburetter air intakes on motor cars where the dust conditions are obviously of serious moment.

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Wear arising from the contamination of lubricating oil is more likely to occur with the Diesel than with the steam engine, particularly when, as is sometimes the case, salt water is used for piston cooling and finds its way into the oil sump at the bottom of the engine through the medium of leaky telescopic or other working joints in the cooling water piping. For the Diesel even more than for the steam engine the choice of proper lubricants for the various parts of the engine is important. The lubricating conditions to be met are more drastic and it is essential that the oil going through the engine be kept in the best possible condition and free from foreign substances and dirt. Here again the centrifugal separator is playing an important part in reducing wear and prolonging engine life.

Even more than with the steam engine the best results in Diesel engine practice not only as regards fuel economy but in the prevention of undue wear and maintenance of a minimum upkeep expense can come only as the result of constant care and watchfulness and last, but not least, from the maintenance of a high standard of cleanliness, not only as to fuel and lubricants but involving engine, auxiliaries and engine room as well.

Diesel Engine Progress

NOTWITHSTANDING the very general and serious falling off in shipbuilding, which characterized the year 1926, the adoption of the Diesel engine for ship propulsion, a development of which there has been steadily increasing evidence during the past several years, not only continued but increased, the output of marine Diesel machinery actually being greater than for any previous year.

According to *Shipbuilding and Shipping Record* there were produced during 1926 something over 500,000 indicated horsepower of marine Diesel engines, a most impressive record and of particular interest in view of the further fact that the average horsepower per ship, of all motorships under construction at present, is in the neighborhood of 5,000. Thus it is evident that not only the total horsepower of internal combustion engines in use on shipboard is rapidly increasing but the capacity of individual units is also growing, the engines now in use or in course of construction being in many instances of a size which but a very few years back was considered quite impracticable.

While the growth of the marine Diesel has been phenomenal, one cannot but feel that but for the multiplicity and wide variation of types, it would have been even greater. There are at present something like 20 different and distinct makes of Diesels on the market and in practice. There are six types of double acting engines use at sea. To further complicate matters there are various combinations of engines with mechanical, hydraulic or electrical reduction and reversing gearing. That the orderly development and progress of the Diesel has suffered because of this multiplicity of types there can be no doubt. The shipowner, of necessity conservative as regards everything bearing upon the safe operation of his vessels, has been besieged by the advocates of this or that type of engine, everyone of them presenting apparently conclusive evidence of the superiority of his own particular type and in some cases, most unfortunately, equally voluble as to the weak points of the engines produced by his competitors. There can be but one result from such short-sighted and ill-advised sales policies. The shipowner himself cannot pretend to expert knowledge; he must, in large part, be guided and form his opinions from what he hears, the result being that if he listens long enough to certain sales propaganda of which there has been altogether too much, he not unnaturally comes to the conclusion that every type of engine has certain weak points which make its adoption on shipboard at best a matter of doubtful expediency.

While most of the Diesel builders have consistently based their arguments on what they know to be the good points of their respective engines and have refrained from undue criticism, some have taken a long time to learn the truth of the saying that "what hurts one, hurts all." Every engine has its individual good qualities and likewise certain characteristics which may invite criticism, but despite the latter the fact is obvious that there are a number which in every way have passed the experimental stage and may be depended upon to the fullest extent. The figures quoted are all the proof that is needed of the fact that the Diesel is firmly established in the shipping industry and that it will continue to grow in importance as time goes on.

Some Encouragement

JUST as this issue of MARINE ENGINEERING AND SHIPPING AGE goes to the press, the news is received that the Congress has sent to the President the naval appropriation bill, and that the bill provides for the commencement of construction of the three cruisers, in regard to which there has been so much discussion.

From the national standpoint, this is encouraging news for it indicates that the Congress has very definitely determined that the country shall maintain the position assigned to it at the naval disarmament conference.

For the shipbuilders there is not so much ground for congratulation. It is at least encouraging to know definitely that the ships are to be built, but the House, in what seems to us a "penny wise-pound foolish" attempt to keep in the middle of the road, cut the cruiser appropriation to a point where it will be possible only to undertake the preparation of plans and other preliminaries during the coming 9 months before the Congress again meets. Still more of the distressful waiting and hoping which has been the lot of the shipbuilders for the past few years seems to lie ahead for them in the immediate future.

So far as merchant shipbuilding is concerned the situation appears much the same; little or nothing has been accomplished during the session now about to close, but there are reasonable grounds for the hope that something may be accomplished at the next.

Most truly "hope deferred maketh the heart sick" but at least one may feel that the pessimism expressed elsewhere in these columns is not entirely justified. There is now the certainty that a number of large vessels and an enormous horsepower of turbines and boilers are soon to be built.

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Simplification and Standardization*

By Rear Admiral G. H. Rock, U. S. N.†

THE present general movement towards standardization in industry is the natural result of the forces which gradually and for a long time have been building up in that direction. Every engineer who has handled large contracts which included projects having similar features has experienced the desire and felt the necessity of simplifying and standardizing in order to save time and cost and to ensure a better product. Many branches of industry drift along aimlessly with an enormous quantity of spare parts and an excessive diversity of sizes and patterns for the same design for every-day pieces of apparatus. This means a vast amount of stock accumulated and turned over very slowly with high costs of production.

By inviting a naval constructor to speak on the subject of simplification and standardization it is presumed that the program committee considered that the subject as applied to the work of construction in the Navy would be of general interest to others. This should be so, for in many ways the Navy has either a direct or indirect interest in every phase of the question. We are interested in nearly every material of engineering; for nearly all are used either on warships or in the navy yards and stations. Naval officers regard the question from the viewpoint of designer, manufacturer, storekeeper, distributor and consumer. All these must be coordinated and directed toward one end, the efficiency of the fleet. In our work on standardization and simplification we act from no selfish motive and we have no ax to grind; our efforts all being directed toward increased efficiency and economy.

Preliminary to a general discussion let us classify the various kinds of standards which are or may be used in the building of ships.

First: Standardization of interchangeable articles purchased or made in quantity—

Articles purchased are such as lenses for air ports and deadlights, pipe fittings, hose, galley equipment, hospital equipment, plumbing fixtures, articles of outfit, etc.

Articles made in quantity by the shipyard or by the navy yard are: Small boats, doors, manholes, air ports, blocks, etc.

Second: Standardization of quality.

This type of standardization is exemplified by specifications, such as those for structural steel, rivets, lumber and practically every other material entering into the completed ship.

Third: Standardization of design and workmanship.

Such standardization is illustrated by type plans of installations, general specifications and the rules of classification societies and other associations, such as the Fire Underwriters. For naval vessels the General Specifications, together with all of the supplements forming part of these specifications, give complete instructions for the workmanship and general design requirements of the entire ship.

Standardization of Interchangeable Articles

Standardization of the type of articles listed in the first class above must be recognized as setting distinct limitations on further progress. When such standards are once set and are widely used, it is almost impossible to change them, even though they are later proven to be defective or obsolescent. Before such standards are adopted this disadvantage should be weighed against the obvious advantages of increased economy, convenience in replacement, uniformity of design, etc.

A ship is probably less susceptible to standardization of this character than most other products of industry, because the ship is essentially a built rather than a manufactured product. Moreover, many of the articles on a ship falling within this class exist in such limited numbers that they are not carried in stock by any ship chandler. Take, for instance, the watertight doors. It is necessary to have numerous types and sizes of these doors to meet the different conditions of access and pressure called for in different parts of ships of different types. Such doors when once made usually last for the life of the ship. The principal expense connected with making these doors is the cost of the materials and the cost of labor. The advantages of universal standardization are quite questionable for an article of this kind, although standards adopted by each great shipbuilding organization, such as the Navy, are found advantageous.

Other articles in the first class are more susceptible to standardization. For example, lenses can be standardized in dimensions, the number of different sizes being greatly reduced. Small boats are built in quantities in certain yards, standard working plans for each size being subject to change only in the Navy Department and are modified there only when tried out improvements are added. The number of different sizes is gradually being reduced. Standardizing the boats means standardizing, also, the handling and stowage gear and appliances.

The work of standardizing hull fittings and items of equipment is going ahead as rapidly as conservative engineering practice and the availability of competent personnel will permit. A thorough understanding of the limitations is necessary, if satisfactory results are to be expected. The work thus far has proceeded along conservative lines and, through the agency of the American Marine Standards Committee, the advantage of the standardization and simplification of ship fittings and equipment are being extended to American merchant ships. Important progress is being made.

Standardization of Quality

In regard to the standardization of quality, it is essential for a government establishment, such as the Navy, to adopt this type of standardization, as the law requires that all purchases made by such an establishment shall be by competitive bidding. Entirely aside from this requirement, however, the standardization of quality of articles purchased is of the greatest benefit both to the user and to the manufacturer. It establishes a uniformity which all manufacturers desiring the business must meet and, therefore, makes it difficult for unscrupulous manufacturers to compete successfully by selling goods of inferior quality. Standardizations of this kind should not be considered as permanently fixed. They should be constantly changed to meet the changes in manufacturing procedure and in the requirements of the users. There can be no doubt that standardization of this kind operates to reduce the cost of materials, as well as protect the reputable manufacturers.

This particular phase of standardization has been given special study for a number of years. Some 10 years ago this work was put on a going basis by the adoption of standard stocks of certain materials. The standard stock lists prescribe the types, sizes and quantities which should be carried in stock at various naval stations. It might be remarked in passing that to keep this standard stock list up to date and worth while requires eternal vigilance and means a labor of love on the part of many who are so constituted that they can keep plodding at a job which is the kind that is never finished.

The quality of materials purchased by the Navy is described in Leaflet Specifications, a system of long standing. These leaflets are being worked on constantly to keep them

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* From an address delivered before the local section of the American Society of Mechanical Engineers at the Cosmos Club, Washington, D. C., on October 26, 1926.

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abreast of the times, with due regard for the progress of engineering practice and, of course, the national program of simplification and standardization. They are sometimes criticized as being too severe; but it has been necessary to make them severe to ensure getting materials that will stand up under service use.

The Navy also uses many materials which fall in a different category; materials which well can be of the best regular commercial grade or standard. As an illustration of progress along this line, we have recently revised one specification for wrenches and have eliminated 49 different types and sizes, a reduction of about 36 percent. Also, we have given up our special dimensioned anchor cables and have adopted and are gradually installing cast steel chain of commercial dimensions together with the new wildcats required on the anchor windlasses. In this work we often encounter difficulties due to the fact that manufacturers of many materials have no trade standards, even as to size. In other materials we find a multiplicity of standards. Unfortunately, there are many standard specifications which have been set up by the trade or by standardization agencies which are not satisfactory from an engineering standpoint and which are not suitable for general use.

Inasmuch as simplification and standardization are not new considerations for the Navy, we are taking active part in the work. We lead as well as follow. Our technical forces are engaged in many problems in connection with the Federal Specifications Board, the American Engineering Standards Committee, the American Society for Testing Materials, the American Marine Standards Committee and the Division of Simplified Practice. It is hoped that our participation may be increased rather than diminished.

Standardization of Design and Workmanship

The art of shipbuilding has probably brought the last type of standardization listed above to a higher state of development than has any other industry. For merchant ships, the requirements of such classification societies as Lloyd's and the American Bureau of Shipping are given in such detail for the various types of ships that the designer must meet definite design standards in order to secure the classification desired. This type of classification or standardization of types of ships serves principally to protect the underwriter, although it also protects the owner and assists the designer. The rules of the classification societies, although definite, are, in general, not hard and fast; they are subject to change to meet developments in shipbuilding and in ship operating.

Corresponding to the rules of classification societies for merchant ships, we have for naval ships the General Specifications for hull and machinery, together with their supplements. These General Specifications and supplements give complete details as to the design and workmanship requirements for naval vessels, but they permit greater latitude to the designer in developing special types. In fact, the Navy feels itself free at any time to depart from the General Specifications, if these specifications are found not applicable to the requirements of new types being designed.

In connection with the question of standard design of merchant ships, you will remember the country was engaged in quantity production of ships during the war. Many ships were built from the same plans; some well built, many poorly built. They were built in record time and accomplished their essential mission. These ships were designed for a definite purpose, and have generally been found unsuitable for peace-time service in competitive commerce in the various lanes of ocean traffic. While they had a large effect in ending the war, and thereby represent a victory in standardization, it must be recognized that this particular application of standard design was successful only for a special set of conditions. This noteworthy instance of standardization teaches us that there are natural limitations which must be studied and not disregarded when we endeavor to undertake standardization in its broadest terms.

Benefits To Be Derived from Standardization

The benefits to be derived from sensible standardization in ship design are quite obvious. Standardization stands for economy and facility; economy in time and money; ease of procurement and assurance of suitability for the intended purpose. These advantages are especially emphatic in the case of repair work, as a merchant ship is a financial liability except when it is underway. Interchangeability is an important asset. We want all fire hose to be of the same size and of similar threads so that it is usable on any ship, and similarly for many other items. Further, interchangeability of personnel in the Navy and in the merchant marine is an important consideration. New personnel on one ship can very readily understand the operation of another ship if standardized equipment and methods are in vogue. This is very important in time of emergency, when the Navy might be called upon to take over and operate many merchant ships. As an example, consider the one item of the marking of pressure piping to designate whether a pipe carries live steam, exhaust steam, salt water or compressed air. The advantage of similar markings on all ships is entirely obvious. Indeed, there are many avenues for simplification and standardization in ship design. It is highly desirable to standardize where practicable; it is essential to avoid standardizing where impracticable.

It must be well recognized then that the program of simplification and standardization is essentially an engineer's job. In undertaking this vast work we must accept responsibility for its outcome. We know it will be a great success of far reaching betterment if it is worked out on a basis of engineering principles; it cannot succeed if it is worked out on the basis of expediency. For the protection of the reputation of the engineering profession, it is essential that engineers should strive to keep this movement strictly on a firm, conservative and, above all, a technical foundation. The mistakes which are made will be far reaching and costly. We must guard against mushroom tendencies, superficial studies and perfunctory action. The setting up of American Standards which cannot be readily accepted by manufacturers and well informed consumers will be distinctly detrimental, and, of course, worse than no standards at all.

I have faith in the work, but I sometimes feel that there is a tendency on the part of the personnel to rush things unduly in order to "make a showing." If my advice were requested, I would say that emphasis should be placed on quality rather than on quantity. Quantity production of American Standards may mean mediocrity and retardment of the work. It is perfectly apparent that "half baked" specifications cannot arbitrarily be set up as American Standards and be expected to stand and enjoy the confidence of consumers and manufacturers.

The various standardizing bodies should definitely recognize this fact. Their failure to do so would destroy the country's confidence in them and would surely limit their success if not cause their failure.

It is not enough that we go through the paper work of setting up American Standards; a specification which is honored by the designation "American Standard" must stand on a sound technical foundation. Such a foundation is best provided by an unselfish, hardworking, technical committee composed of members who are interested, able and sincere. The tendency for listless action on the

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part of such a committee jeopardizes the progress of standardization. It results in the establishment of American Standards which are *expedients* instead of sound technical specifications. I cannot too forcefully emphasize my sincere hope and feeling that the American Standards which are set up may be worthy of the name. I am fully aware that technical effort on the various committees is voluntary and gratis. It can hardly be expected that the members of the committees can continually work for their regular employers by day and for American standardization by night. The success of standardization depends entirely upon industrial support, financial as well as moral. If the large commercial concerns would assign to the committee work the requisite number of competent engineers, the movement is bound to succeed, in quantity as well as quality. Without such support, success is questionable. In any event, in adopting "American Standards" let us maintain the highest standard.

In this connection, we might consider the relation of the Federal Specifications Board to the work of the various standardizing bodies. The question is asked, "Why cannot the Federal Specifications Board adopt and use the specifications which have been promulgated as American Standards instead of duplicating the work by writing other specifications, thus weakening the position of the standardizing societies by withholding Government support?" That important question has been frankly answered somewhat as follows: "U. S. Government Master Specifications are written (and revised when necessary) by as unbiased technical committees as it is practicable to obtain for the purpose of providing adequate specifications for competitive government purchase of materials; and the business goes to the lowest responsible bidder. Whenever an 'American Standard' definitely provides a material of the grade required, the government specifications can well be identical to the earlier established standard." In a number of instances standard commercial specifications are accepted. Further progress in this regard would result from increased cooperation between standardizing societies and government representatives.

The recent war demonstrated that the older methods of warfare must give way to those devised from the results of research and the President requested the National Academy of Sciences to organize the scientific resources of the country for the national defence. The Academy appointed a committee which later resulted in the organization of the National Research Council of the National Academy of Sciences. After the armistice the President issued an executive order requesting the National Academy of Sciences to perpetuate the research council under its charter on a peace basis. Other governments likewise in the same emergency called to their assistance their scientists and fostered research in the directions necessary to carry on the war. Standardization is akin to research and could not make much progress without its assistance.

The necessity for conservatism in the adoption of standards is apparent to all who are working on the subject. We do not gain much by issuing a national standard if the manufacturers ignore it nor if the conditions do not justify it. Consider the situation as regards aircraft at the outbreak of the war—standardization in design was detrimental to progress, but was essential when mass production had to be introduced to manufacture in large quantities in times of emergency.

Standardization and simplification have for their object increased efficiency by the more economical use of resources, thereby reducing waste, increasing output, and reducing productive costs. Standardization releases energies otherwise wasted in the endless labor over details. Industrial standardization and simplification made it possible to produce the automobile at a price which makes it generally available. The necessity for studying standardization in detail and comprehensively is one of the great problems before our industry. It will require all the cooperation, all the knowledge, and all the patience of which human nature is capable to solve this problem, but in the solution is great hope of progress.

In closing, I want to commend the American movement for simplification and standardization. In December 1921 our government constituted under the Department of Commerce the Division of Simplified Practice, a national campaign towards elimination of national waste. It makes for economy, facility and progress. Its influences are widespread; it provides for increased production and distribution of the comforts of life; it leads to better homes and higher standards of living; it is an American ideal worth striving for.

Growth of American Foreign Trade

THE quantitative growth of American foreign trade in recent years is shown in a report of the Shipping Board representing our trade during the fiscal year 1926 as 1,174,000 long tons greater than it was during the preceding twelve-month period. The total cargoes of our water-borne foreign commerce during the most recent fiscal year amounted to 94,183,000 long tons. The report, which was developed by the Bureau of Research, under the direction of Commissioner P. S. Teller, indicates a sharp increase in the demand for imported raw materials for manufacture in this country. Due largely to this situation, our total imports advanced 2,553,000 tons, as compared with the preceding fiscal year, to an aggregate of 43,589,000 tons. Exports, on the contrary, largely because of a poor wheat crop, showed decline of 1,379,000 tons, and a total of 50,593,000 tons for the fiscal year.

Conditions in our markets in Europe contributed largely to these changes. In 1926 our exports to Atlantic and Mediterranean Europe amounted to about 22,230,000 tons, a decline of 2,470,000 tons in comparison with shipments to these regions in 1925. The 1926 imports received from Europe were nearly 2,000,000 tons, 25 percent greater than the 7,700,000 tons received in 1925. The only other region showing a decline in exports is Mexico, this change being a logical complement of the fall in Mexican oil imports. Asia and the Far East took nearly 800,000 tons more of American products in 1926 than in 1925; exports to South America increased 440,000 tons, and the export trade with Central America and the West Indies increased 213,000 tons.

The tanker traffic, although of less general interest than the dry cargo trade, includes about 24 percent of the total cargo tonnage movement involved in our water-borne foreign commerce and its fluctuations materially affect the traffic totals as expressed in tons. For instance, in 1926 the tonnage of dry cargo imports exceeded 32,000,000 tons, an increase of nearly 4,684,000 tons over 1925, but a decrease of 2,131,000 tons in tanker imports, due to the decline in Mexican oil movement, reduced the total import increase to the 2,553,000 tons mentioned. On the other hand, the 1926 dry cargo export total of approximately 39,000,000 tons was 1,698,000 tons less than the previous year, but the increasing development of domestic oil supplies was sufficient to permit tanker exports approximately 319,000 tons greater than in 1925, thus reducing the total export loss to 1,379,000 tons.

THE Newport News Shipbuilding and Drydock Company, Newport News, Va., has been awarded a contract to recondition the S.S. *America* at a cost of $1,894,000, the ship to be delivered 360 days after the work is started.

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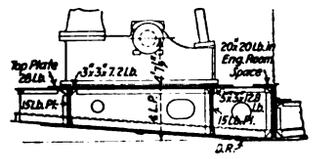
Excursion Steamer City of Keansburg

Twin screw vessel for service in New York harbor has accommodations for 2,300 passengers

NOTWITHSTANDING the fact that the automobile has had the effect of very materially reducing the business of many of the lines of harbor and excursion steamers plying in the neighborhood of our large coast cities, there still continues a certain demand for new and improved vessels of this type and with the steadily increasing and well nigh impossible week end congestion of roads and highways, signs are not wanting that the public is turning back, in increasing numbers, to water in its search for rest and recreation.

One of the latest additions to the fleet of excursion steamers operating in New York harbor is the *City of Keansburg*, a twin screw vessel which maintains a summer service between New York and Keansburg, New Jersey, on the lower bay.

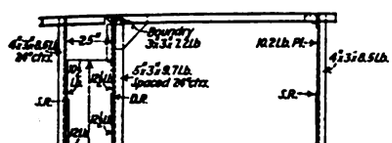


Section through engine room

Main Particulars

The new vessel was designed by Mr. Townsend J. Smith, naval architect, of Brooklyn, New York, and built at the Marvel shipyard at Newburgh. Her general particulars are as follows:

Length, overall	241 feet 7 inches
Length, inside stem and stern posts	230 feet 0 inches
Beam, extreme	43 feet 0 inches
Beam, at waterline	36 feet 0 inches
Depth, molded	12 feet 6 inches



Section at bunker

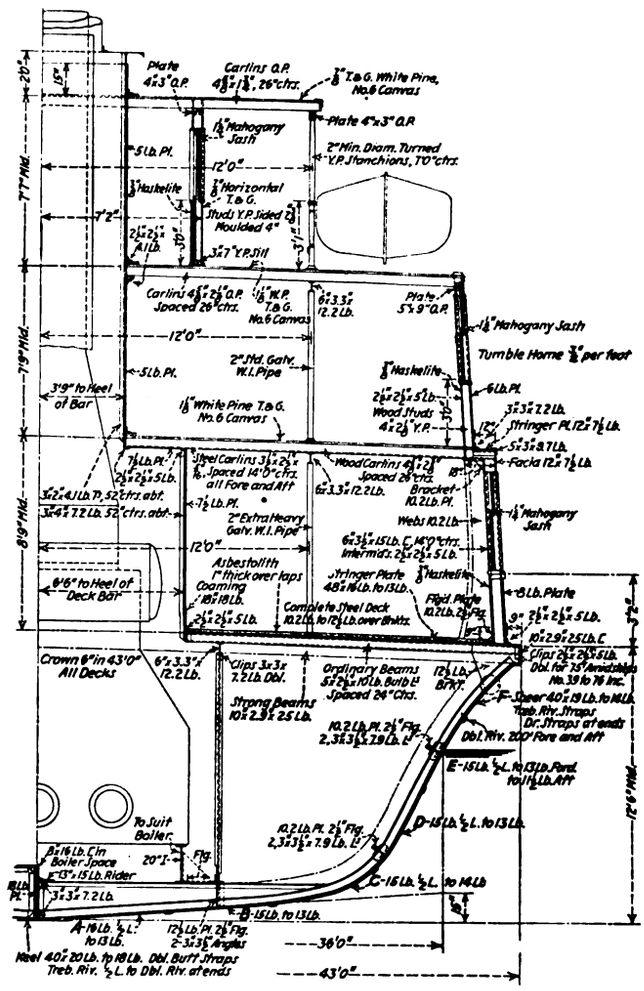
Draft, forward	7 feet 0 inches
Draft, aft	8 feet 6 inches
Tonnage, gross	1,037
Tonnage, net	551
Passenger capacity	2,300
Fuel oil capacity	80 tons

The hull is single bottomed, of steel, with the flaring topsides usual in this type of vessel. It is subdivided by 6 watertight and 2 oiltight transverse bulkheads into forepeak, forehold (containing crew's quarters), boiler room, fuel tanks, engine room, after hold (containing cafeteria, with steel deck and shaft space beneath), after peak and lazarette and quadrant space. A deep water tank is fitted in the forehold, below the crew's quarters.

The fuel oil tanks, located between the engine and boiler rooms, are 14 feet in length and extend transversely 9 feet each side of the centerline to longitudinal oiltight bulkheads. The spaces outboard of the latter are utilized for listing or transverse trimming tanks. A watertight pipe and passageway trunk is fitted through the port trimming tank.

Hull Construction

Above the main deck, steel topsides are fitted up to the sills of the saloon deck windows, continued, on the main deck, in steel bulwarks to the stem and stern. A steel house is fitted aft on the main deck, containing a spacious dancing floor with staircase to the cafeteria below. This deck is completely plated, the plating being covered with asbestolith composition inside the house including the dance hall. A steel transverse bulkhead is located forward of the boiler casing, forming the forward end of the main deck enclosure, and from this point to the bow, a calked wood deck is laid. The engine and boiler casings, extending from the main



Midship section

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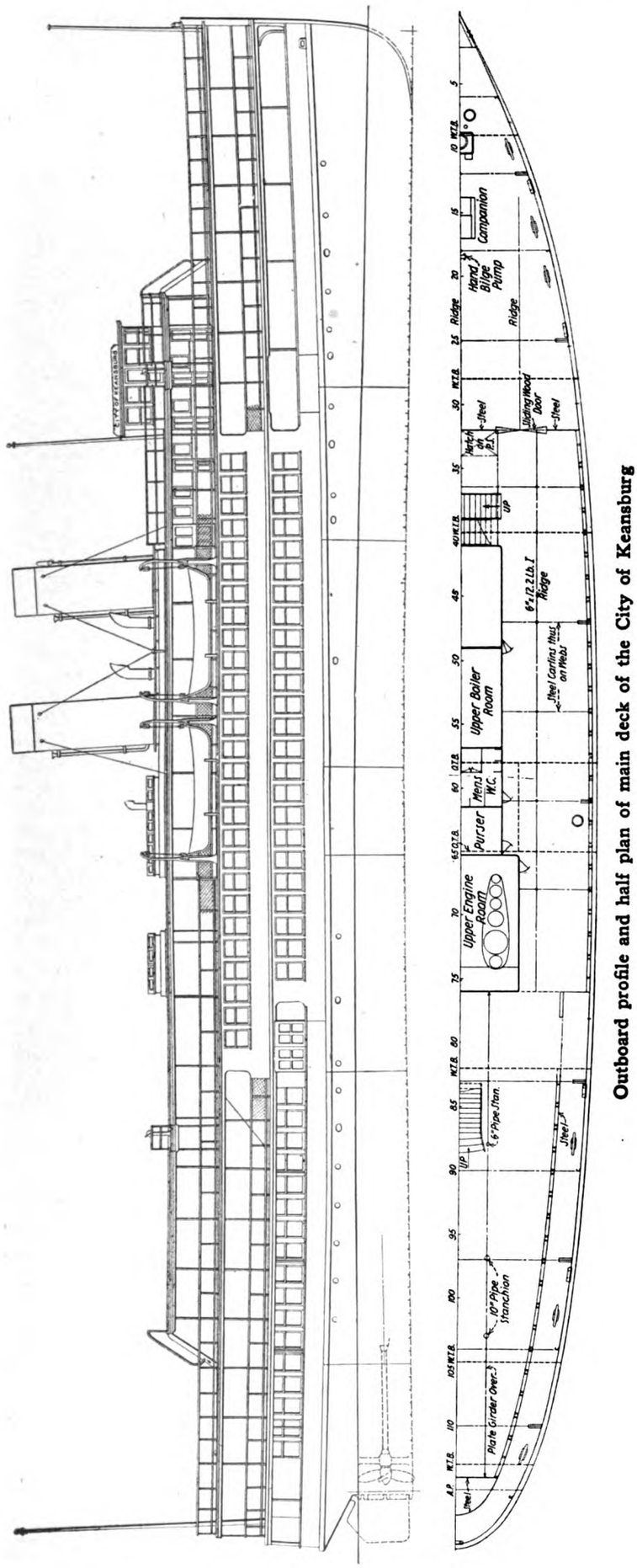

Outboard profile and half plan of main deck of the City of Keansburg

deck to well above the shade deck are of steel as are the various divisional bulkheads on the main deck.

The saloon, boat and shade decks are of joiner construction covered with canvas where exposed to the weather and strengthened by steel carlines and stanchions at frequent intervals. As will be seen from the plans, all enclosed spaces are provided with the maximum possible number of windows, all of which are fitted with sliding sash and pullman balances, thus contributing to making the steamer an ideal one for warm weather service. The dancing hall is sheathed with Haskelite which is also extensively made use of in other portions of the joiner construction.

PROPELLING MACHINERY

The propelling machinery consists of two 3-cylinder triple expansion engines, having cylinders 15½ inches, 26 inches and 44 inches in diameter by 26 inches stroke, driving twin screws. The propellers are 4 bladed of semi-steel, 8 feet 6 inches in diameter and 13 feet pitch. The line and tail shafts are 8 5/16 inches in diameter, supported at the outboard ends by cast steel struts. The total horsepower developed is from 1,500 to 1,800, giving the vessel a speed of over 18 statute miles per hour.

Steam at 200 pounds working pressure is supplied by two watertube boilers of the U. S. Shipping Board type, each having 2,518 square feet of heating surface, and each fitted with a 400 square foot Power Specialty Company superheater. A Coen fuel oil burning system is installed.

The auxiliary machinery includes a Bethlehem air pump, 12 inches by 24 inches by 15 inches; a single cylindrical surface condenser having 2,697 square feet of cooling surface; a Worthington feed pump, 10 inches by 6 inches by 12 inches; a 10-inch centrifugal circulating pump and engine; a Buffalo ballast and fire pump, 10 inches by 6 inches by 12 inches, and a Reilly feed heater.

A Bethlehem steering engine of the drum type having 7-inch by 7-inch cylinders and a 6-inch by 6-inch Hyde steam capstan and windlass are included in the hull equipment.

The electric plant consists of two Engberg 10-kilowatt generators and approximately 250 standard 25-watt lights and a searchlight together with numerous outlets for fans, portable, special fixtures and running lights.

Great Lakes Steamer Launched in England

A STEAMER for service on the Great Lakes of North America and on the St. Lawrence, which is being built to the order of Mr. Playfair of Midland, Ontario, for the Valley Camp Coal Company, Ltd., was launched from the Neptune Shipyard of Swan, Hunter & Wigham Richardson, Ltd., on February 1. The vessel, which is a self-unloading bulk freighter, is nearly 260 feet in length by over 43 feet beam and will carry over 2,000 tons deadweight on a draft of a little over 14 feet. She will be equipped with triple expansion engines fitted aft.

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The Value and Limitations of Propeller Charts*

IN our issue of August 19 there appeared an article in which Froude's propeller curves were presented with revised notation. No doubt the new method of presentation will be of definite use to some designers who have not yet found their bearings in relation to the original charts for design. It is perplexing to students of ship propulsion to find the lack of harmony which exists among the results of experiments with model screws. When Froude's 1886 propeller curves were the only ones which were at a designer's disposal he straightway set about to find his basis whereby to interpret these into practical values. The restricted field which was covered by Froude in these early experiments induced other experimenters to make more comprehensive schemes, and different methods of presentation commended themselves to these experimenters. Work in this field by Durand, Taylor, Curtis and Hewins, was undertaken and published in the early years of this century. Froude himself, dissatisfied with the scope of his earlier work, published in 1908 the results of a complete new series of experiments. This was followed in 1910 by Taylor's fresh results in his "Speed and Power of Ships." Subsequent to this, Schaffran made and ran an exhaustive series of experiments, and presented his results in a form which differs from all those previously given.

One would imagine that an experimenter who had schemed out the scope of his research and had carefully plotted the results which had been recorded in his experiments would have been anxious to advocate the use of his particular charts in preference to those given by other authorities. We find Taylor, however, commending for general acceptance a composite set of diagrams derived from the published results of Froude, Schaffran, Durand and his own. By submitting these for general acceptance Taylor's action suggests that an equal degree of care had been taken by each of these experimenters and that the broad facts which govern the action of screw propellers are definitely indicated in all their results.

These composite results suggest also that a broad view should be taken when dealing with the problem of propulsion. If one approached Froude's charts with certain data, such as the thrust horsepower to be delivered, the revolutions, the speed of ship and an experimental wake value, in all probability the dimensions suggested by Froude's curves would be at variance with those which Taylor's charts would give. For this reason it has always been advocated in these columns that designers should adopt one particular set of charts as their guide and by means of analysis of trial results be able, with some degree of confidence, to link up these experimental results with actual practice.

When it is borne in mind that the basic data with which one approaches the subject of propeller design is by no means definite, it seems out of proportion to state the diameter and pitch for assumed conditions to small fractions. Thus a propeller, say, 20-foot diameter and 18-foot pitch, would perform almost the same as one 20-foot 3½-inch diameter and 18-foot 1¾-inch pitch. When arriving at the latter dimensions the assumptions which were made in the particular case to which they apply were (1) that the thrust horsepower was 2,200; (2) that the speed of the ship was 12½ knots; (3) that the wake was 35 percent; (4) that the revolutions were 67 per minute. It is admitted that some definite data must be assumed when attempting to arrive at a solution, but there is considerable room for error in the assumptions made. The thrust horsepower cannot be accurately estimated; there is no guarantee, were the estimated thrust horsepower actually delivered, that the speed would be that assumed; that the wake estimated is that which will exist at the ship; or that the revolutions of the engines when delivering the power will be exactly that stated. Accordingly a reasonably wide margin can be allowed without violation of the dimensions which an apparently accurate solution suggests.

Propeller charts give no guidance in several important directions. In one particular case which has come under our observation fairly accurate records of the effective horsepower were available, the experimental wake value was known, and the propeller dimensions were determined on the basis of this data. . The ships' performance did not bear out the results which had been anticipated on the basis of the experimental data. Apparently the positions of the screws in relation to the hull did not permit of these functioning as they ought to have done, nor could this be revealed by small-scale experiments. The fact remains that the trial and subsequent performances were below the standard which had been set.

With regard also to the amount of surface to allow, propeller charts give no definite guidance. They undoubtedly do direct as to the variation in efficiency which may be expected with change in disk area ratio, but the actual area must be determined before entering upon the charts for the solution of the problem. It is not sufficient to assume that if the cavitating pressures are not exceeded that the area provided should be suitable: in actual practice the pressures vary from 5 pounds to 15 pounds per square inch of expanded surface. The suitable pressure for the particular case must be chosen, and the area necessary to meet this pressure and the expected total thrust must be determined before the design is proceeded with.

Lastly, in exceptional cases, the propellers suggested by the charts are not those which experience has shown to have higher efficiency. In the case of one ship with a small center screw operating between two large slow-running propellers a much better performance was given with a small diameter and large pitch ratio than with one of larger diameter and small pitch ratio, which had been suggested by the curves for design. In another vessel, this time having twin screws with high revolutions, the propeller charts had suggested the adoption of very low pitch ratio screws. These were fitted and found to be most inefficient and were replaced by screws of lesser diameter and greater pitch ratio, which gave much better results.

In this problem of propeller design the results of experience must be associated with those of experimental research, and the designer will be uncertain of his ground until he has made himself acquainted with the actual performances of propellers in the propulsion of full-sized ships in actual service.

* From Shipbuilding and Shipping Record.

Lightship Equipped with Diesel Engine

LIGHTHOUSE *No. 111*, the first vessel in the U. S. Lighthouse Service of the Commerce Department, to be fitted with a full Diesel engine for propulsion has been completed and placed on Northeast End, N. J., off the entrance to Delaware Bay. The hull, deck houses and interior quarters are constructed of steel with a minimum amount of wood, reducing the fire hazard.

The fog signal apparatus consists of an air driven siren, the sound being distributed through a four-way cast iron multiple horn located over the engine trunk. The propelling engine is of the full Diesel type constructed with eight cylinders and is direct reversible by compressed air. The vessel is staunchly constructed and appears to have good seagoing qualities, and rides well in rough weather without discomfort to the crew.

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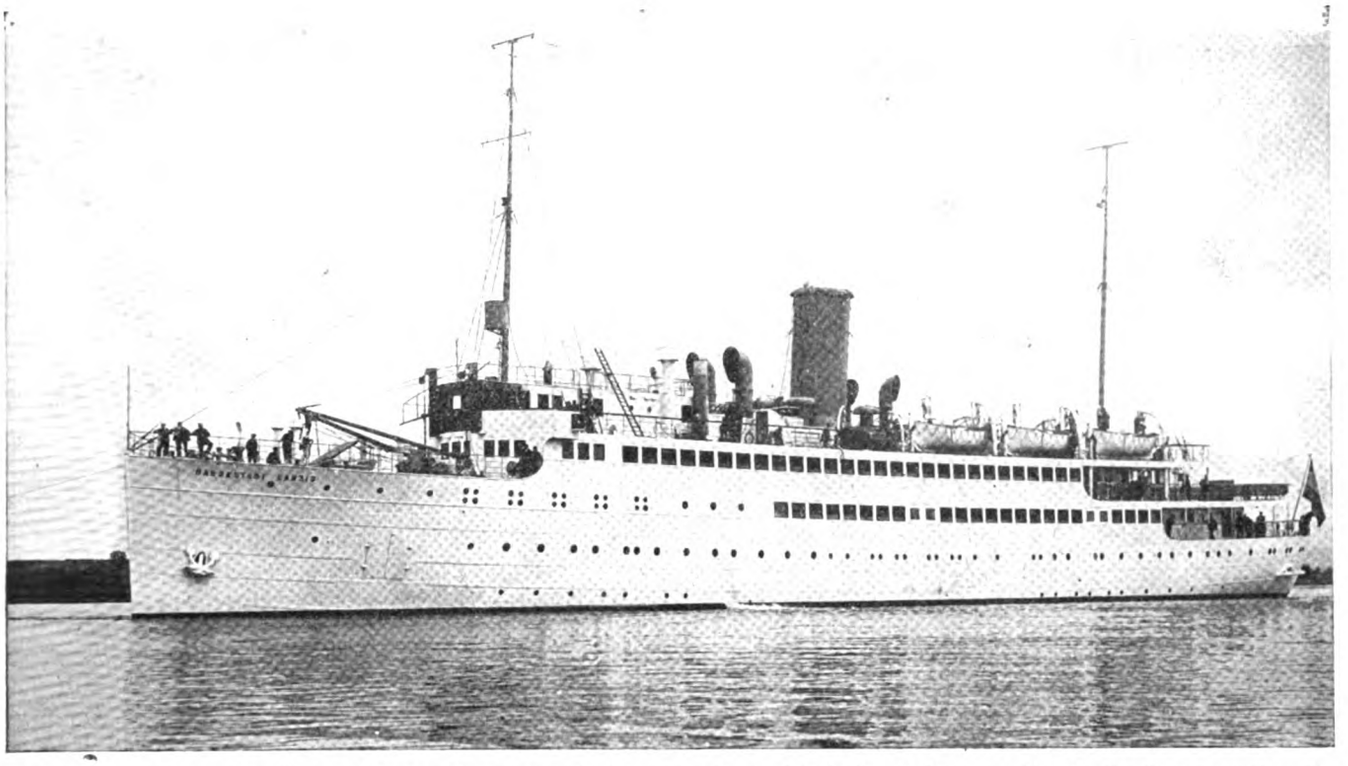

The German motorship Hansestadt Danzig equipped with supercharged Diesel machinery. She is the first vessel to be provided with exhaust gas turbine driven superchargers

Supercharging Diesel Machinery

A new method of reducing weight and cost by the use of exhaust gas turbine driven blowers

By Our Special London Correspondent

IT is some two or three years since the principle of supercharging Diesel machinery was introduced in Europe. A number of ships were built in which oil engines were installed, capable of developing up to 15, or, as a maximum, 20 percent, above their normal output when supplied with air at a pressure of about 2 pounds per square inch (gage). Many designers and builders have been averse to this arrangement but, possibly in view of the demand for cheaper and lighter machinery for a given output, there is now a tendency to adopt supercharging in new motorships.

The most important example of supercharging that has yet been made will be found in the two 23,000-ton motor passenger liners *Saturnia* and *Vulcania* which are being built for the Cosulich Line, for their service to South America. The two Burmeister & Wain-type double acting, four stroke engines are designed to develop normally about 18,000 brake horsepower but a maximum output of 20,000 brake horsepower is needed and the additional power is gained by supercharging. It is probable that the electrically driven blowers will be brought into action only occasionally when it is necessary to make up lost time, and, indeed, in most instances where superchargers have been installed, it is for the purpose of providing a higher output only for a short period. For instance, the two recently built Holt cargo liners *Idomeneus* and *Orestes* are equipped with four cycle, twin screw machinery which normally develops 8,000 indicated horsepower but this can be raised to 9,000 indicated horsepower when the combustion air is supplied from the electrically driven superchargers.

In almost all the vessels in which supercharging has been employed, the air is obtained from rotary blowers coupled to electric motors. In two Italian ships, however, that have lately been built, the *Stelvio* and the *Terese Odero,* a novelty has been introduced by coupling the blowers to Diesel engines. In order that these supercharging machines should be of moderate size, they must rotate at high speed, whereas the Diesel engine is a comparatively low speed unit. A speed increasing gear is therefore interposed between the Diesel engine and the blower, and in the ship in question the oil engine runs at about 300 revolutions per minute and the blower between 2,500 and 3,000 revolutions per minute.

An extension of the principle of supercharging has lately been brought to a commercial stage and is arousing a considerable amount of interest. Two large passenger ships for service in the Baltic were built for the German Government, although operated by private owners. They are the *Hansestadt Danzig* and the *Preussen* respectively, and are propelled by 2 ten cylinder, four stroke, single acting engines of the high speed M.A.N. type, driving the propellers through Vulcan hydro-mechanical gearing.

It frequently happens that it is necessary to increase to a considerable extent the normal speed of the vessels in order to make up time, and supercharging is then resorted to. Instead, however, of adopting the ordinary method of drive, the supercharging blowers are coupled direct to exhaust gas turbines, these turbines receiving the exhaust gases of the propelling Diesel engines. In the ordinary way, when the combustion air is drawn from the atmosphere,

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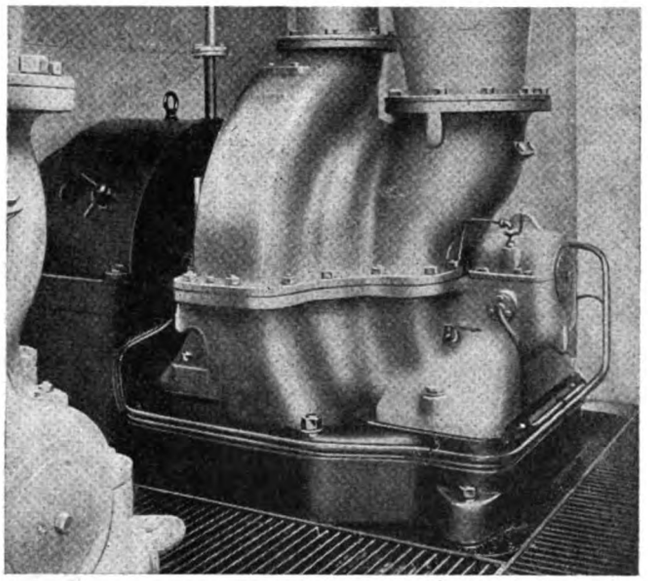


Exhaust gas turbine driving a supercharging blower as fitted on the M. S. Hansestadt Danzig

the output of each of the two motors is in the neighborhood of 1,700 brake horsepower but when the superchargers are brought into action, it is stated that an increase in power to the extent of some 50 percent is attained.

THE SYSTEM OF SUPERCHARGING

This system of supercharging, known as the Büchi, has been developed by the Swiss Locomotive Works, Winterthur, and Brown, Boveri & Company and experiments have just been concluded to demonstrate exactly what can be accomplished. The 500 brake horsepower, four cycle, single acting engine, of which an illustration is given, was arranged so that the exhaust gases should be supplied to the exhaust turbine seen on the left, this latter being coupled to a supercharging blower with two stages. From the blower, the air is delivered to the cooler seen in front of the engine and thence passes direct through the inlet manifold before entering the cylinders through the inlet valves. The Diesel engine is of quite ordinary design and no modifications are made to it except that the timing of the inlet and exhaust valves is altered. During a period when the pressure of the exhaust gases is less than that of the supercharging air, a surplus supply of air enters the cylinder, scavenging out the exhaust gases and serving also to cool the tops of the cylinders and cylinder covers.

It will be gathered that in order to obtain sufficient power from the exhaust gases to drive the blower, they must be cut off before they reach atmospheric pressure, and actually they are delivered to the turbine at a pressure of between 7 and 8 pounds per square inch. After passing through the turbine, they are discharged through the silencer, but it may be understood that their temperature has only slightly fallen and they may be utilized for raising steam in an exhaust boiler if required.

The pressure of the supercharged air is also about 7 pounds per square inch and is, therefore, very much higher than has previously been employed in ordinary supercharging systems. At this pressure, with the corresponding additional weight compared with the combustion air in a normal cycle, the air is able to support the combustion of a much greater quantity of fuel, hence to give a larger output. Actually, this four cylinder Diesel engine, which is sold in the ordinary way as of 500 brake horsepower at 250 revolutions per minute, has had its rating raised to 750 brake horsepower for continuous service at the same speed, and it has an overload capacity up to 1,000 brake horsepower.

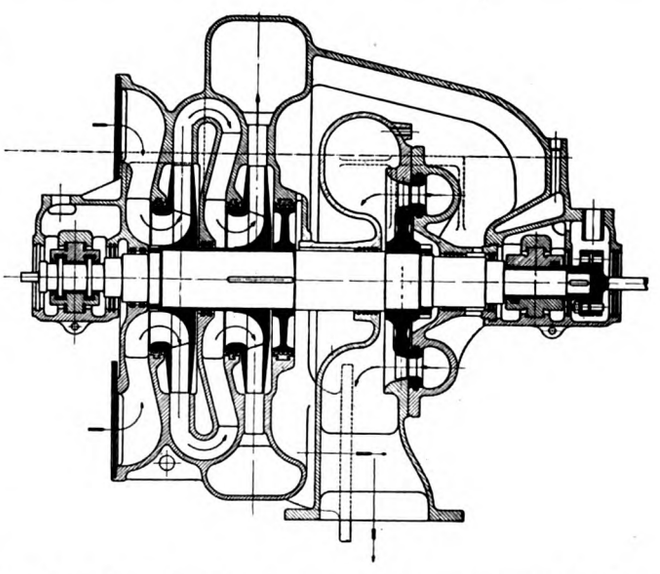
Naturally, the mean effective pressure has been increased and it may be thought that the same effect could be obtained by designing an ordinary Diesel engine with higher mean effective pressure. The difference, however, lies in the fact that, with the system just described, the exhaust gas temperature remains as it was without supercharging, while the maximum pressures are not increased, the amount of heat carried away by the water is no greater, and the conditions so far as general stresses are concerned are no more severe in this engine when rated at 750 brake horsepower than with the unsupercharged motor developing 500 brake horsepower. The torsional stress in the crank shaft is increased, but it is claimed that this is not of any great importance.

RESULTS OF TESTS

Some of the results of the tests may be recorded as showing the conditions, and it may be added that in America a large Diesel engine is being built by the Curtis Company to operate on this system and to develop about 1,800 brake horsepower. The exhaust gas temperature is in the neighborhood of 350 degrees F. with the engine developing 750 brake horsepower and the mean effective pressure is about 114 pounds per square inch. The fuel consumption is 0.41 pound at 750 brake horsepower whereas the consumption of the same engine without supercharging and running at 500 brake horsepower is about 0.42 pound per brake horsepower hour. This improvement is largely due to the fact that the mechanical efficiency is higher than in the unsupercharged engine, on account of the reduced proportional value of the frictional losses.

It may, perhaps, be objected to this system that the whole tendency in Diesel engine design at the present time should be towards simplification of design in every respect. On the other hand, the increasing competition between various types of engines and also from the newer classes of steam machinery, renders it imperative for the full possibilities of the Diesel motor to be explored.

It is claimed that, as the normal rating of an engine can, in this way be increased 50 percent at the expense of a comparatively cheap plant, such as an exhaust gas driven blower, there will be a considerable saving in the cost of constructing Diesel engines of given power, while the



Section through exhaust gas turbine and supercharging blower, as used on 500 brake horsepower engine

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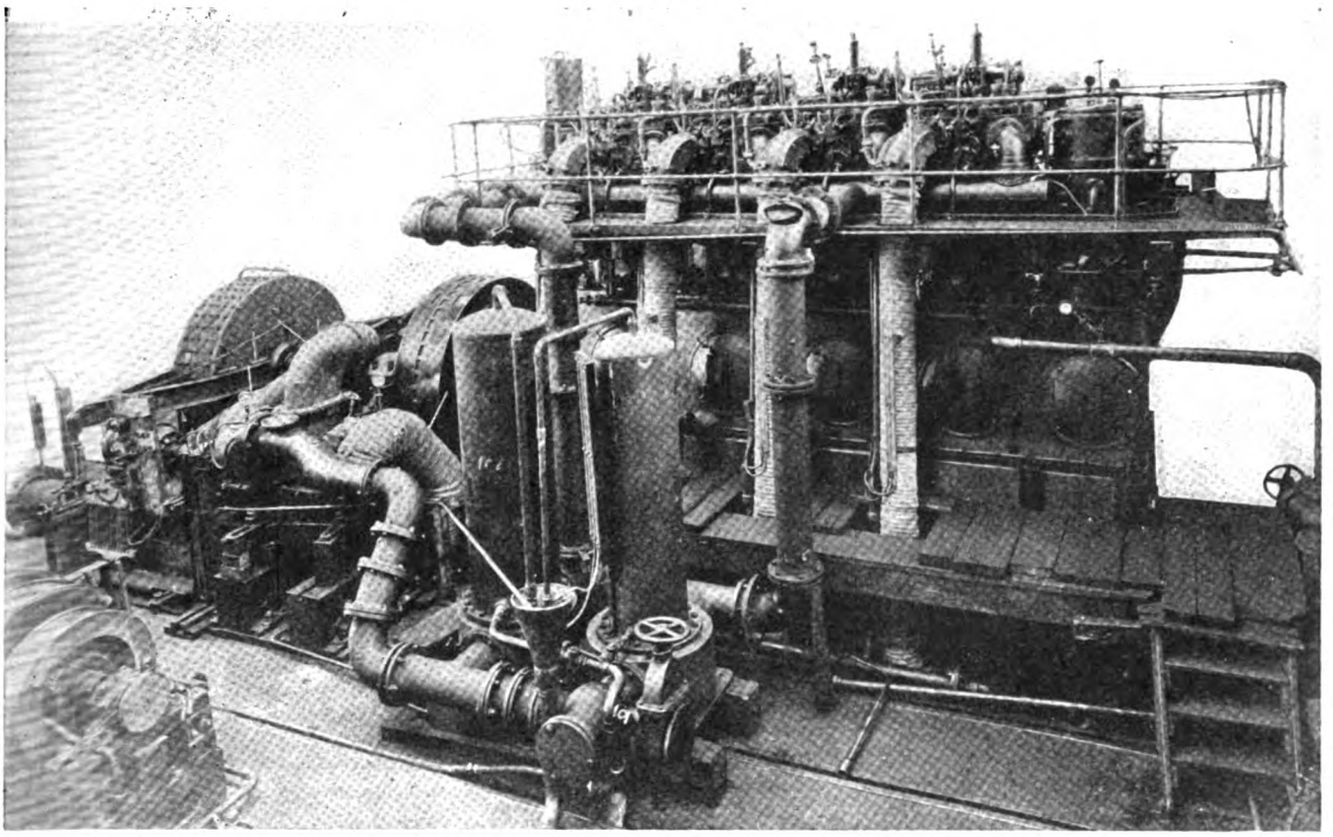

500 brake horsepower Diesel engine with exhaust gas turbine driving a supercharging blower. The output is raised to 750 brake horsepower continuously with an overload capacity up to 1,000 brake horsepower

weight and space occupied will also be diminished more or less in proportion. Rapid progress is likely to be made in the near future and an engine is being built, normally rated at 1,200 brake horsepower which will, with the supercharging blower driven by the exhaust gas turbine, develop 1,800 brake horsepower continuously.

American Vessels Get Only One-Third of Freight Revenue Paid for Overseas Cargoes in American Foreign Trade

AMERICAN-FLAG vessels are receiving only about one-third of the freight revenue paid for ocean transportation of cargoes in American foreign trade, according to a special report submitted to the Shipping Board by Philip S. Teller, commissioner in charge of the board's Bureau of Research.

The report, as the result of an exhaustive study undertaken by the bureau, estimates the total freight cost of our foreign trade during the fiscal year 1925 at $598,896,553.36. Of this, the report states, $198,721,354.60, or about 33 percent, represents the freight revenue of American vessels.

The report is based on actual transactions during the period considered, and is the first report of its nature ever compiled upon such a basis.

The total amount paid for ocean transportation of dry cargoes during that year was approximately $487,000,000. Freight paid on tanker cargoes aggregated $102,000,000. The freight cost of the Great Lakes foreign commerce was $9,787,000. These three items produce the total quoted above.

Analyzing the earnings of American vessels in their several activities, it develops that they receive 59 percent of the Great Lakes freight, 50 percent of the tanker freight and 29 percent of the dry cargo freight; their total aggregating 33 percent of the revenues earned by all vessels employed in transporting the foreign trade of the United States.

The domestic water borne commerce of the United States is restricted by law to American-flag ships. During the fiscal year 1925 they earned $64,248,998 in the intercoastal domestic traffic through the Panama Canal and 55,574,492 in the Great Lakes domestic trade. The addition of these items brings the freight charges paid in 1925 for water transportation in foreign trade and in domestic trade through the Panama Canal and on the Great Lakes to a total of $718,700,000.

Following are tables containing an analysis of total freight paid in our foreign trade and of the freight earnings of American vessels in foreign trade.

	Imports	Exports	Total
Dry Cargoes	$201,372,806.63	$285,651,429.68	$487,024,236.31
Tankers	34,964,297.94	67,120,782.07	102,085,080.01
Total Ocean Freights	$236,337,104.57	$352,772,211.75	$589,109,316.32
Great Lakes Freights	3,760,649.76	6,026,587.28	9,787,237.04
Total Foreign Commerce	$240,097,754.33	$358,798,799.03	$598,896,553.36

The freight earnings of American vessels in foreign trade and their percentage ratio to the totals in the above table were as follows:

	Imports		Exports	
Dry Cargoes	$58,232,664.68	(29%)	$83,982,262.56	(29%)
Tankers	27,093,306.02	(78%)	23,612,133.42	(35%)
Total Ocean Freights	$85,325,970.70	(36%)	$107,594,395.98	(31%)
Great Lakes Freights	2,826,327.62	(75%)	2,974,660.30	(49%)
Total Foreign Commerce	$88,152,298.32	(37%)	$110,569,056.28	(31%)

	Total	
Dry Cargoes	$142,214,927.24	(29%)
Tankers	50,705,439.44	(50%)
Total Ocean Freights	$192,920,366.68	(33%)
Great Lakes Freights	5,800,987.92	(59%)
Total Foreign Commerce	$198,721,354.60	(33%)

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Cast Iron for Diesel Engines

By F. Johnstone-Taylor

THE continued increase in the power developed by Diesel engines has considerably stimulated research into methods of producing better cylinders. While in one or two instances use is made of steel for that part of the cylinder subject to the greatest heat, the large majority of Diesel engines including those built for the very highest powers make use of cast iron, because on the one hand it affords the most feasible means of forming intricate sections and on the other because it has a good wearing surface. The main trouble with which Diesel engine builders are confronted in respect to cast iron is that the metal must possess adequate strength at high temperatures and retain its size and form and be free from cracking under such conditions. This trouble was apparent enough when large double acting gas engines were the fashion in the power field, but by patient investigation much has been done towards the production of really reliable castings which will stand up to the exacting conditions of Diesel engine practice.

Apart from good design and skilful foundry work, it is the composition of the metal which will largely determine the success or failure of a Diesel engine cylinder, its head or piston. For instance a high carbon content while facilitating the foundry work is detrimental to the product, in that the free carbon or graphite has a weakening effect. The principal difference between various grades of cast iron arises from the degree of weakening of the matrix by graphite. The matrix again which has many of the properties of steel contains carbon which is in combination. It is something equivalent to steel of similar carbon content, but broken up by plates of graphite so that even when the composition is strictly controlled, a homogeneous grey casting is, under ordinary foundry conditions, an impossibility. It is with the object of successfully overcoming this defect in cast iron that metallurgists and founders have been collaborating for some time.

It is quite well known of course, that iron with a low silicon content is conducive to a superior casting, but foundry conditions render the use of such iron difficult. Again it is also known that a certain distribution of the graphite is desirable and that iron which contains the maximum amount possible of combined carbon without free cementites helps to ensure a good casting. This is the condition of perlitic iron, which is well known among other things to have great resistance to wear and it is the basis of the new Perlit process which is attracting the attention of Diesel engine builders in Great Britain and Europe.

The process is quite a definite one which consists in the production of an iron which when cast in a cold mold is mottled but when cast in a heated mold is grey. The composition of the iron is varied to suit the average thickness and the mass of the casting, as also is the temperature to which the mold is pre-heated. The metal so obtained has considerably different properties to those of ordinary cast iron. Its chief constituent is perlite, but its special properties are not wholly due to this fact, but largely to the character and the distribution of the graphite inclusions. These in ordinary iron occur in the form of flakes, which becoming progressively larger and coarser in proportion to their distance from the surface destroy the cohesion of the metal in some degree, whereas in this Perlit iron they remain the same size irrespective of mass or of varying sections in the casting.

This fact has been well demonstrated by micro photographs. The metal therefore has a definite homogeneity and a test bar from wherever taken is truly representative of the metal in any section, and this fact again has been amply demonstrated by test bars cut from several different parts of castings of variable section.

Apart from the superiority of the metal itself, the risk of foundry defects is considerably reduced. For instance in ordinary castings by reason of the difference in the rate of cooling of a thin section adjacent to a thick one, the former solidifies much more rapidly. It thus tends to close up the passage by which the thicker portions should properly be fed with fresh molten metal to fill up the cavity left as solidification proceeds and so gives rise to porosity. With the process outlined, partly by reason of retarding solidification by casting in a hot mold—an essential part of the procedure—and because the structure of the thin and thick portions are precisely the same, the latter show no porosity nor difference in grain. Then again, in ordinary cast iron, a thin section solidifying first contracts and pulls on a thick section adjoining and as this is often still in a pasty condition, cracks and internal strains may result. These by the present method are in a great measure avoided.

In addition the hard chilled layer which frequently occurs on the outside of ordinary cast iron is absent, machining is facilitated and high polish may be obtained by wet grinding. The metal is relatively ductile and malleable; when hot it can be twisted and bent, while in use it has considerable resistance to shock. The silicon content being low, the metal tends to resist "growth" and cracking when subject to repeated heating and is in consequence obviously well suited to internal combustion engine practice.

The procedure outlined undoubtedly marks an advance in the production of strong castings of reasonable weight. Even quite thin sections which in ordinary cast iron might break by falling on to a hard floor will resist repeated blows with a heavy hammer. The tensile strength, always a weak point with cast iron, may approach 25 tons per square inch. Very thin castings are feasible, while on the other hand such intricate pieces as Diesel engine cylinder heads, and a complicated design may often require 20 cores, have been successfully formed of this metal.

New Sounding Instrument Developed by Coast and Geodetic Survey

A NEW instrument known as an electric depth indicator has been completed in the Coast and Geodetic Survey. It is to be used in measuring the depth to which the sounding tubes have been lowered, replacing the rod and scale used heretofore. The instrument is entirely self-contained and is attached to the top of a slightly modified sounding tube by means of a bayonet joint.

Reading is made by pushing the rod, which is part of the instrument, down into the tube until the point of the lower end comes in contact with the water. This completes an electrical circuit which passes through a pair of ordinary radio head phones, making a loud click in the ear of the observer. As this rod is pushed down it causes a dial to revolve on which is a scale reading directly in fathoms. A movable pointer which keeps in contact with this scale indicates the exact depth to which the tube has descended. The new instrument has been sent to the Coast and Geodetic Survey vessel *Pioneer* for a thorough field test after having passed office tests successfully.

MERCHANT MARINE PERSONNEL.—The personnel of the active documented vessels of the United States during 1926 totaled 217,193, according to Merchant Marine Statistics for 1926 just made public by the Department of Commerce. Yachts of American registry carried a crew of 7,184 during 1926 as compared with 7,793 during the previous year.

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Development in the Constructional Details of German High Powered Marine Oil Engines*

By Dr. Ing. Rembold

TWO periods can be traced in German marine oil engine development. The first period began in 1910 and ended at the outbreak of war. A feature of this period was the general tendency to depart from the proven four stroke of land practice and incline to the two stroke with its practically double power per unit cylinder volume and consequently reduced size and weight. The general appearance of the engine, bed plate formation, columns, bearings, lubrication, etc., on the other hand followed accepted marine steam practice. Similar tendencies were evident in foreign practice although a few firms concentrated on the four stroke and drew but little from marine steam practice.

The difficulties in way of the normal development of the two stroke were, unfortunately, found to be much greater than was at first expected. Nevertheless valuable experience was obtained and even now is being utilized in the present design of two strokes. Unfortunately this technical success has not, so far as many German firms are concerned, been accompanied with the commercial success that many foreign firms who adhered to the four stroke have enjoyed. The principal reason for this failure was undoubtedly the outbreak of war, rupturing as it did the complete development of the high powered marine oil engine. During the war, however, valuable experience was gained with the submarine Diesel, which, of course, will be of great value to oil engine development generally.

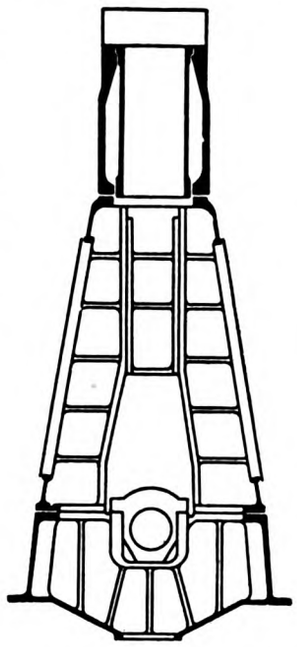
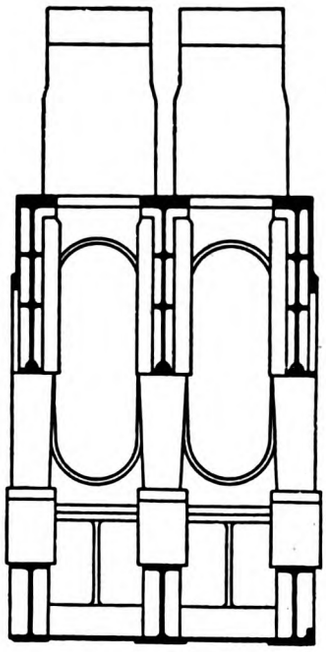


Fig. 2.—A-columns above main bearings



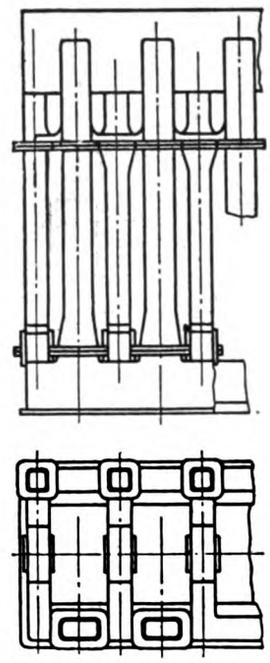


Fig. 3.—Displaced columns

The second period began with the end of the war. Although a number of the two strokes built before the war, necessarily modernized of course, are still in satisfactory service and the vessels in which they are installed being appreciably more economical than the steamer, yet post-war development has been almost generally along four stroke lines. Too little experience was available with two strokes, and thus because of financial difficulties the safer course of four stroke construction was adopted. Only Messrs. Sulzer adhered to the two stroke, due, no doubt, to their adoption of port scavenging, thus greatly eliminating cylinder cover difficulties. Only during the last two years has the two stroke been revived by other firms and now it can be reasonably supposed that its difficulties have been mastered or are in course of being overcome.

The development of the principal constructional features may now be considered in considerable detail.

Columns

The load on the cylinder covers can be transmitted to the bed plate in various ways.

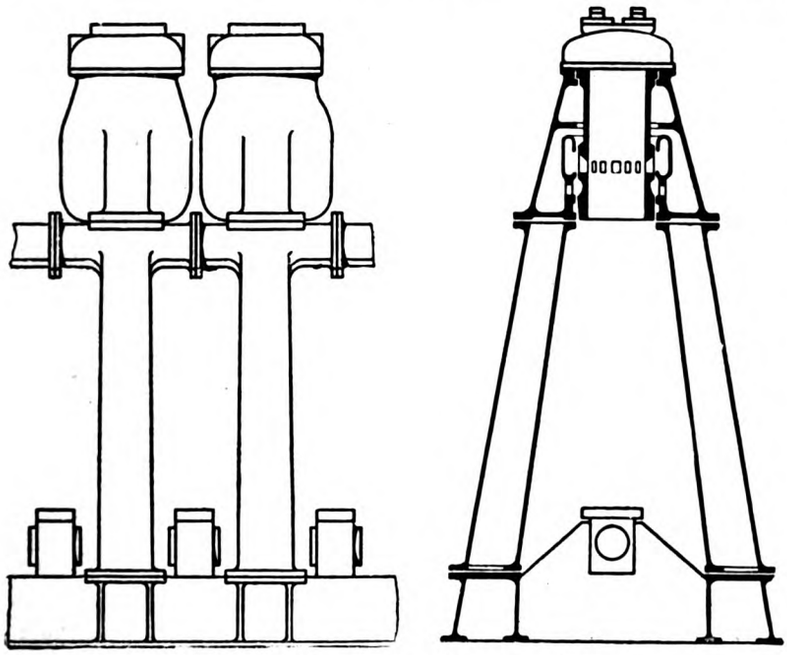


Fig. 1.—Columns athwart the cylinders

* Translation of an article published in *Schiffbau*, July 21 and August 4, 1926.

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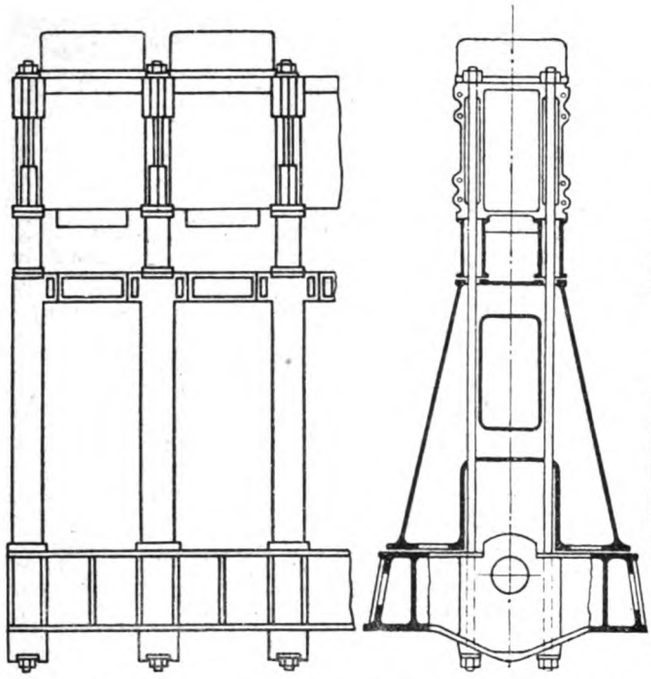

Fig. 4.—Cast iron columns with wrought iron tension bolts

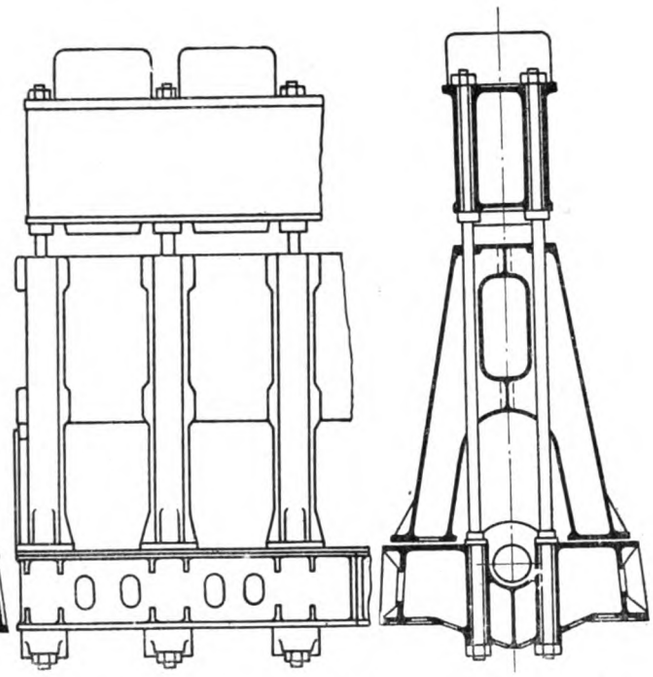

Fig. 5.—Stanchions with cast iron support columns

For example, as in steam practice, cast iron columns may be used, so spread that the cylinders come between the columns. This practice has however been almost entirely discontinued. A very common current practice is the use of cast iron A-columns erected above the main bearings or occasionally between the bearings. The first alternative admits of a narrow engine and reduces the bed plate stresses, while the second has the advantage of greater accessibility. Figs. 1, 2 and 3 illustrate the various alternative forms.

The load transmission can also be effected by wrought iron anchor bolts. The bolts are generally led from the underside of the bed plate to the upper edge of the cylinders, or as in more recent practice to the top of the cylinder covers. Cast iron columns are used of course in conjunction with these bolts, the purpose of these latter being to relieve the columns of all tension. Fig. 4 and 19 illustrate this type of construction. The bolts must be set up with a relatively high initial stress thus preventing gaping of the cast iron flanges.

A third type of construction consists of cylindrical stanchions enclosed by cast iron columns serving only to take the crosshead forces, weight components set up especially in a seaway, and to secure the longitudinal rigidity of the engine (see Fig. 5). This design has, to the author's knowledge, been adopted only by a British firm. Werkspoor at one time used stanchions, the crosshead pressure and transverse components being taken up by cross bolts. Werkspoor has however dropped this design due to the consequent difficulty of crank and connecting rod lubrication.

Which of the foregoing designs is the best cannot yet be decided. German builders have generally preferred the simple cast iron column. The M. A. N. previously adopted this practice but now prefer the column and tension bolts design. Sulzer development is just the reverse.

The column and bolt type admits of a relatively light bed plate. The columns, however, because of the compression imposed on them by the tension bolts and also from the point of view of casting, must preserve a minimum thickness. When the columns are too weak they can be dangerously stressed during erection. The erection of this type of engine is by no means simple, since the heavy tension bolts cannot be given the requisite initial stress by the nuts alone, but require to be heated. Fig. 6 shows how simply the cylinder forces can be transmitted by these tension bolts to the bed plate (see also *Motorship*, 1924, page 198).

The relative merits of these alternatives have recently been closely investigated by one firm, for the case of single acting and double acting two strokes. The investigation showed that the combined tension bolts or stanchion column comes out somewhat lighter than the simple cast iron column. Since the machinery weight in merchant ships is not of overwhelmingly vital importance it was decided

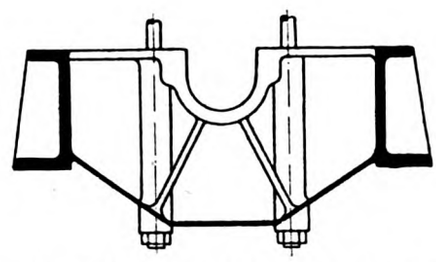

Fig. 6.—Tension bolt connection to bed plate

that the preference in single acting engines, on the score of cost and ease of erection, must therefore be given to the stanchion type and in double acting to the simple cast iron column. In this latter case it is of course assumed that such a design is adopted as will permit of its stresses being readily calculated and hence allowed to be relatively high.

Bed Plate

Present practice seems to favor making the longitudinal and transverse girders forming the bed plate in still longer units and in the form of double T-girders in preference to box girder, thus saving weight and reducing cost as much as possible.

Main Bearings

The old question whether round or square bushings should be adopted for main bearings is still undecided.

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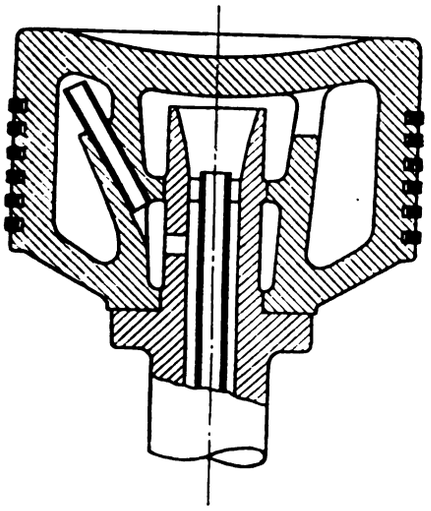
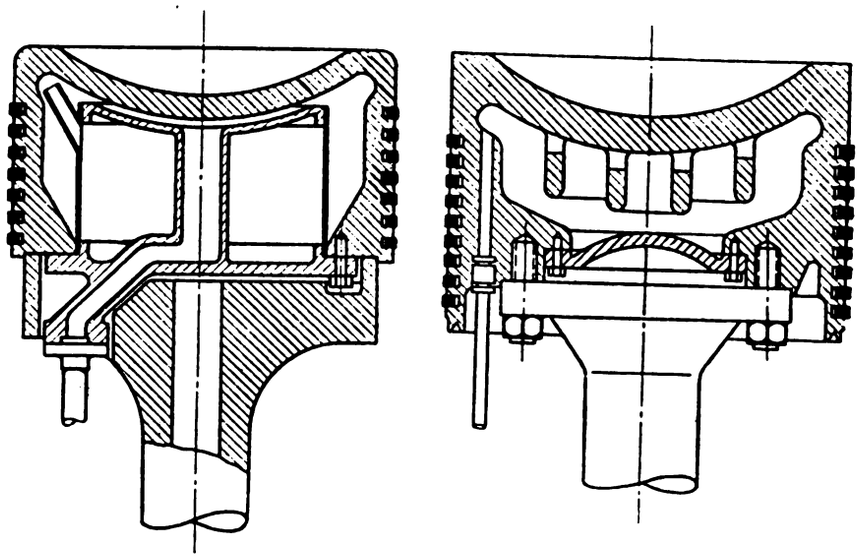


Fig 7.—Early piston design



Figs. 8 and 9.—Modern piston designs for average size four-stroke engines

Both types, by way of compromise, can well be simultaneously adopted. The round bush is the more usual: it is cheaper to make and is withdrawable. The square bushing has the advantage that when worn it can be set up with strip packing thus avoiding the need of remetalling. Large and heavy round bushings cannot easily be mutually adjusted without raising the shaft. The advantages of both types can however be largely secured by fitting round into square bushings.

PISTONS

Pistons before the war were, almost without exception, of the type shown in Fig. 7. The cooling water entered through a pipe in the hollow piston rod, and left via the annulus surrounding the pipe. In design it was endeavored to secure that the inner forces coming upon the inner side of the piston be directly taken by the piston rod. The piston was therefore fitted with ring formed ribs on the bearing face of the piston rod. The forces acting on the outer face of the piston are transmitted through the cylindrical part of the piston and the cone-formed lower surface to the piston rod. Had the upper face not been exposed to the high temperature of the burning gases this type of construction, correctly built, would probably be the best available. Due to the great heat of the upper surface this latter is generally made hollow since, when it is too flat, cracks are developed not only at its connection with the cylindrical ribs but at the piston walls. The piston head in some cases has also become loose. This was found to occur in one single acting, two stroke where, with the piston only taking compressive forces, heavy knocking took place in shutting down the engine, the cooling water escaping below. In four strokes, due to the less heating, this particular piston design is less troublesome. It is nevertheless now generally avoided even in four strokes since marine conditions with their frequent maneuvring with cold air necessitate a too rapid cooling of the combustion chamber walls.

In recent four strokes the center stiffening has been done away with and the piston head made stronger and greater

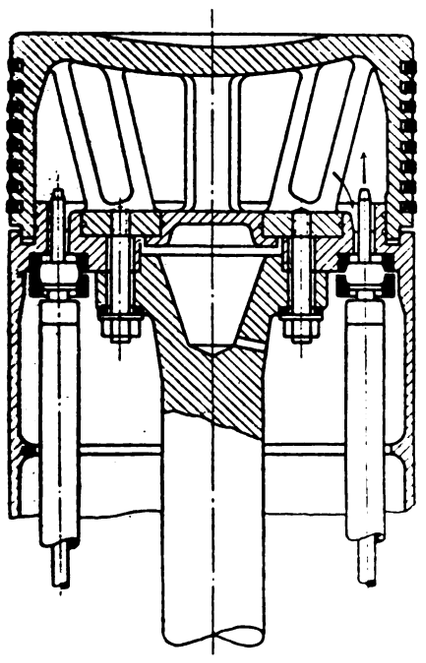
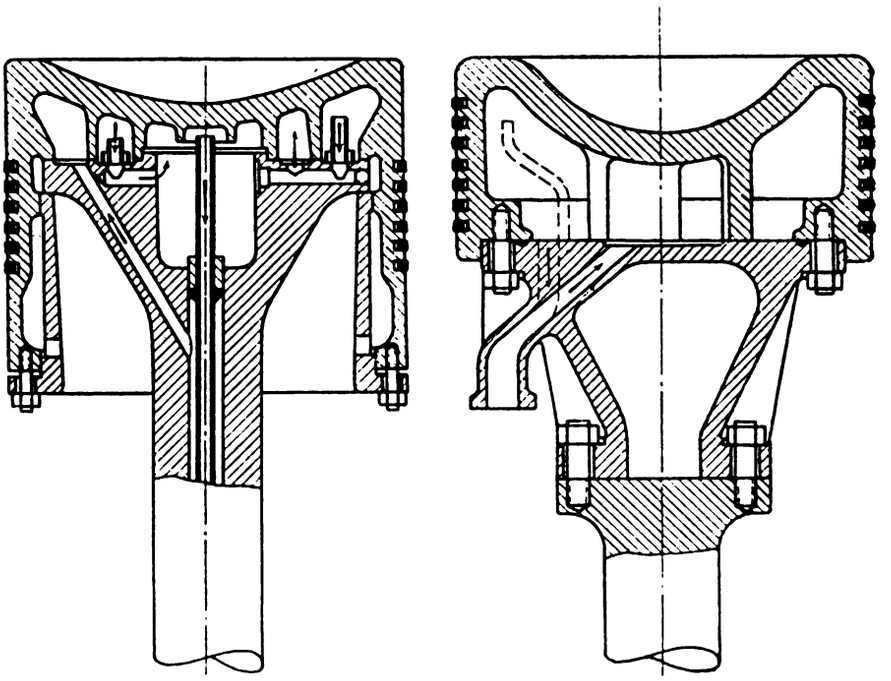


Fig. 10.—Two-stroke piston design



Figs. 11 and 12.—Piston design for large four-stroke engines

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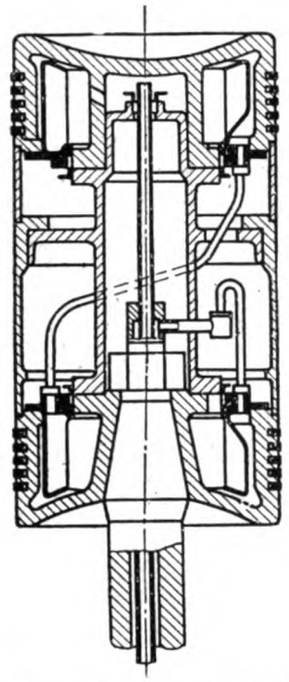
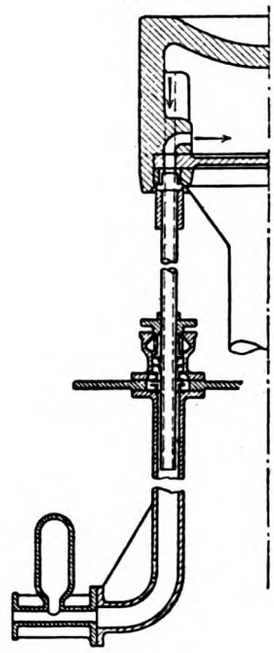
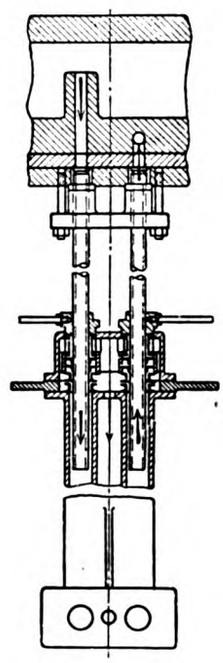
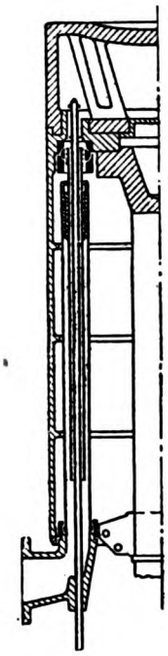


Fig. 13.—Piston design for a double act-acting, two-stroke engine







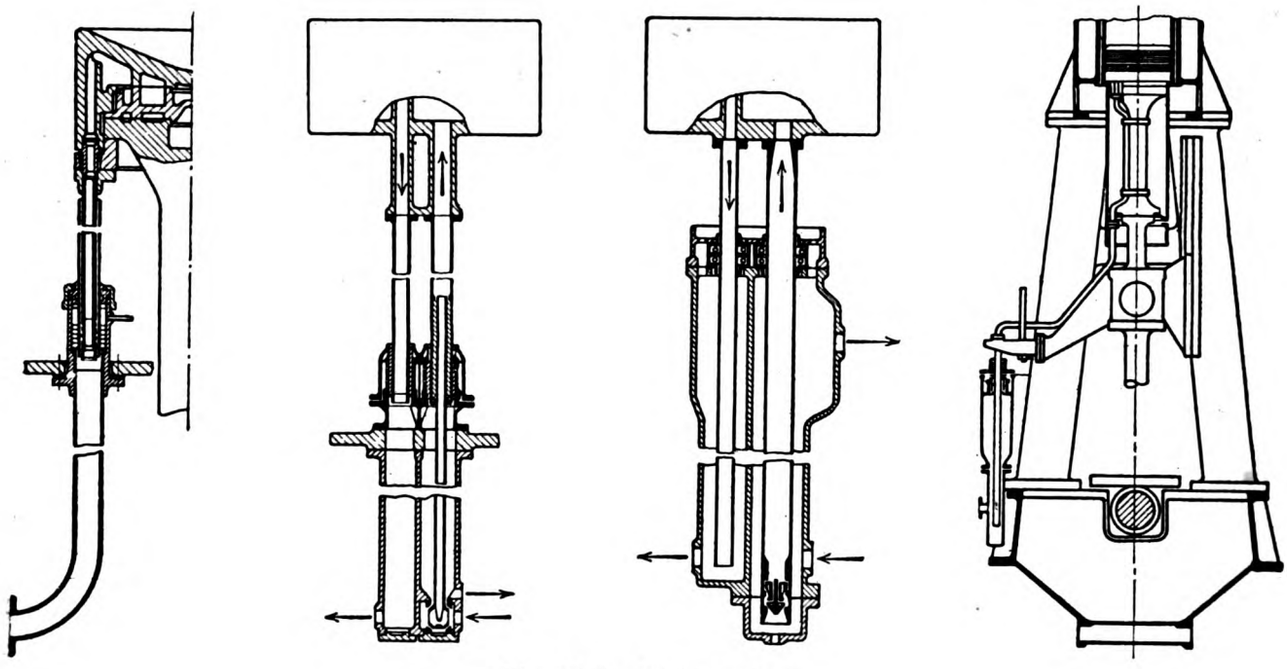
Figs. 14 and 15.—Piston cooling

cooling water velocity adopted (Figs. 8 and 9). In this latter connection, when salt water is used, only one material should be adopted throughout the piston to avoid the possibility of corrosion. This particular design is quite satisfactory provided the diameter is not too great.

For large four strokes and two strokes generally it is however not satisfactory; and internal stiffening particularly with very hollow piston heads is now more usually adopted. This stiffening is either of a form which admits of ready expansion or the piston is made entirely of cast steel in order to keep the piston head walls as thin as possible (see Figs. 10, 11 and 12). A similar design is usual in double acting engines with of course the difference of a further opening for the piston rod (Fig. 13).

Great care must be given to the design of the parts conveying the cooling medium to the piston. In crosshead engines, water is practically exclusively used. With early engines salt water was not adopted, due to feared sediment and corrosion difficulties. Fresh water was therefore used but was itself salt water cooled. It was soon found that other difficulties existed. Oil mixed with the fresh water and adhered to the cold tubes in the return cooler and affected the cooling. Water leakages also occurred and, to make up the loss, salt water was frequently used.

The water was led through knuckle jointed and trombone pipes but on long voyages neither of these were found to remain tight. Water thus found its way into the oil in the crank pit and thus the bearings were actually lubricated



Figs. 16-19.—Piston cooling

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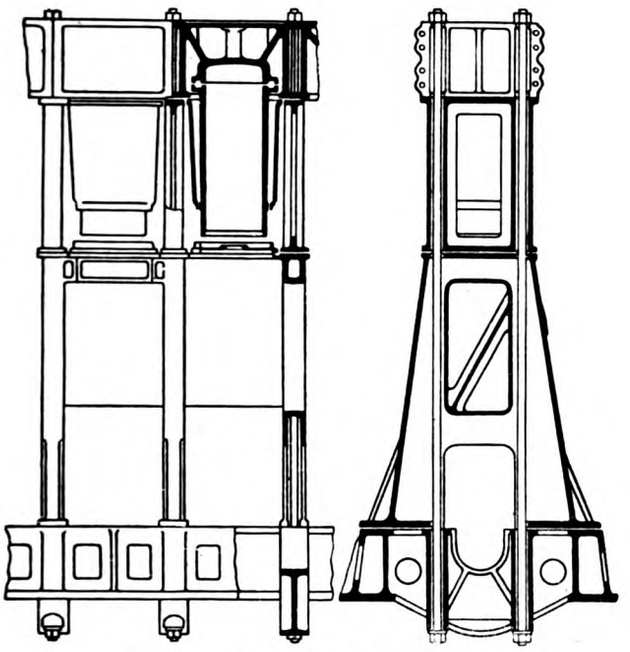

Fig. 19a —A. E. G. cylinder design

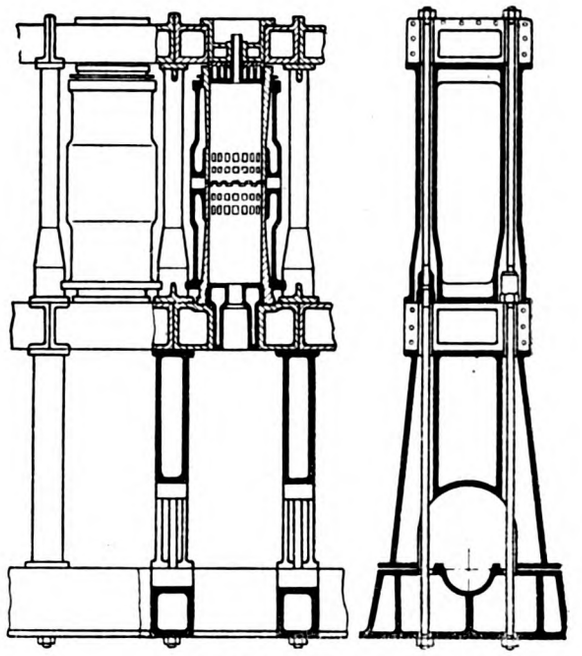

Fig. 20.—M. A. N. cylinder design

with an oil-water mixture with the result—and especially with sea water—that the bearing metal very rapidly eroded.

The first advance was the construction of satisfactory cooling water leads which would remain definitely tight. This enabled salt water cooling to be adopted. It was soon found that knuckle jointed pipes could not be sufficiently simply arranged to prevent water finding its way into the lubricating oil. For this reason, in crosshead engines, trombone pipes are now almost exclusively used. Various designs have been evolved which satisfactorily prevent leakage. In single acting four strokes it is now a general practice to separate the upper and lower parts of the engine by means of a horizontal division plate (Fig. 14). By thus separating the cylinders from the crank pit the combustion products and cylinder oil deposits are kept clear of the bearing lubricating oil; and further by disposing the cooling water leads above the division plate, a most satisfactory solution of water leakage has been secured.

In single acting, two strokes and double acting engines this division plate would involve, however, too high an engine. To prevent water leakage into the lubricating oil in these cases it is now usual to fit the trombone pipes outside the engine and connect them by an arm to the crosshead. By cleading the arm oil loss is avoided. Various designs which have been adopted to avoid water and oil mixing are shown in Figs. 14, 15, 16, 17, 18 and 19. A few of the designs are so arranged that the external stuffing boxes have only to withstand spraying water.

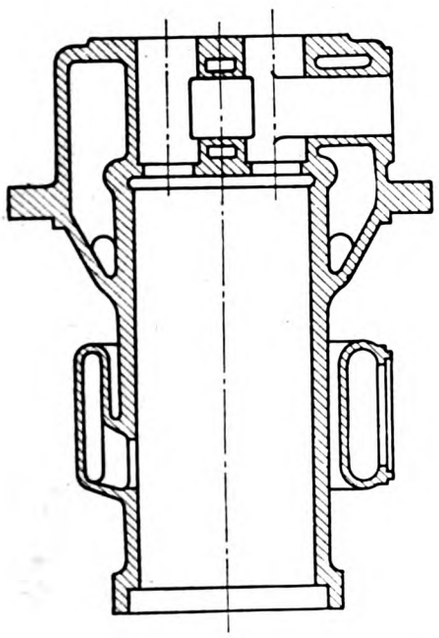

Fig. 21.—One-piece cylinder and cover

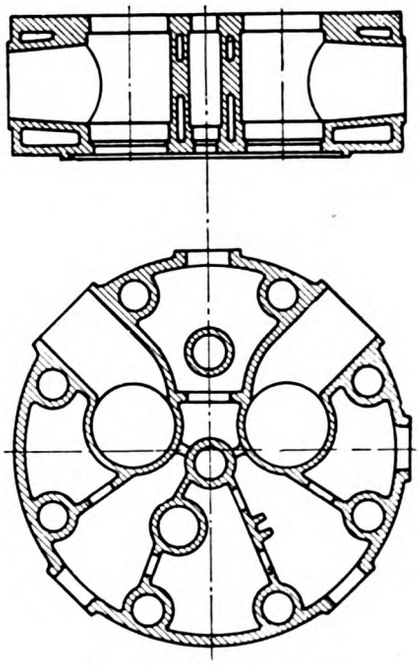

Fig. 22.—Cylinder cover

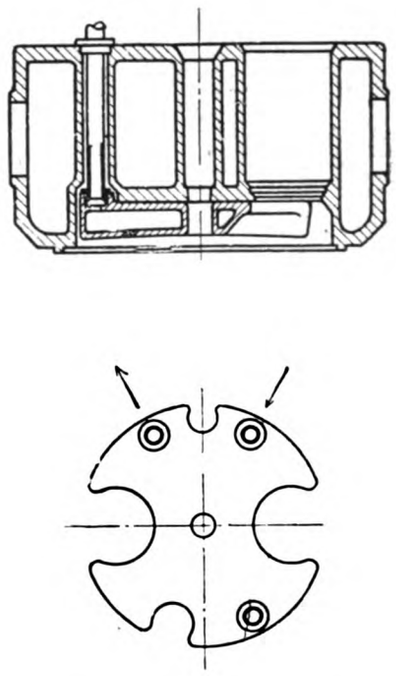

Fig. 23.—Germania Werft cylinder cover

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CYLINDERS

While, originally, cylinders used to be cast singly, with the development of the four stroke engine it became more customary to cast in sets. More recently, however, a return has been made to the single cylinder practice and an endeavor is made to avoid axial tension in the material, the function of the cylinder being regarded as a water jacket round the liner and in two stroke engines as a means of supplying air and exhausting gases. Fig. 19 shows the A. E. G. cylinder design while Fig. 20 that of the M. A. N. for their respective new two stroke engines. In each case a bottom plate supports the water jacket and lower liner, while a built-up top plate takes the upper liner. The two plates are connected by anchor bolts and tie pieces.

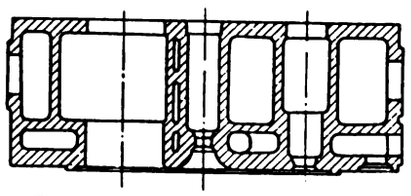

Fig. 24.—M. A N. cylinder cover

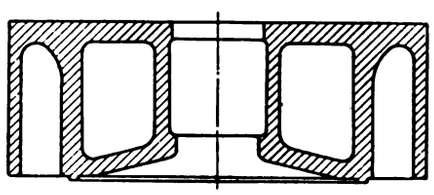

Fig. 25.—Sulzer cylinder cover

CYLINDER COVERS

The greatest trouble in the development of the high powered marine oil engine has been the cylinder cover. In the first engines, land practice was followed and so far as average powered engines were concerned, with some success. With large four strokes and two strokes, particularly with valve scavenging, the covers cracked between the valves. Before the war the cover and cylinder liner were usually cast in one piece in order to avoid heat accumulation in the dividing walls. This design, however, was soon discontinued, since a cover fracture or worn liner required the renewal of a relatively large casting. Cracks also were found to occur at the top of the cylinder jackets. Previously the under faces of the cover were very heavily constructed while the upper were much thinner. Present practice is just the reverse of this. The lower face is made relatively thin to ensure good heat transmission while the upper is made rigid and serves as a support for the lower. Care is also taken that the cooling water can pass between the valves with high velocity (Fig. 22).

In order to obtain the highest possible water speed over the lower face a special partition is provided. The Germania Werft arrange a special water chamber below the cover in order to obtain a high water speed over the surface exposed to the greatest heat and further in case of damage to have only a relatively small casting to renew (Fig. 23). The Deutsche Werke cover for their high powered engines is built up of several parts. A simpler expansion of the lower heated surfaces is thereby obtained since these do not adjoin relatively cold parts in any one casting (Fig. 20).

With two stroke engines an important simplification in cover design has been brought about by the adoption of port scavenging. From Fig. 25 the relatively simple design of the Sulzer cover, made possible by fitting fuel, starting and safety valves in one in-set piece, can be seen.

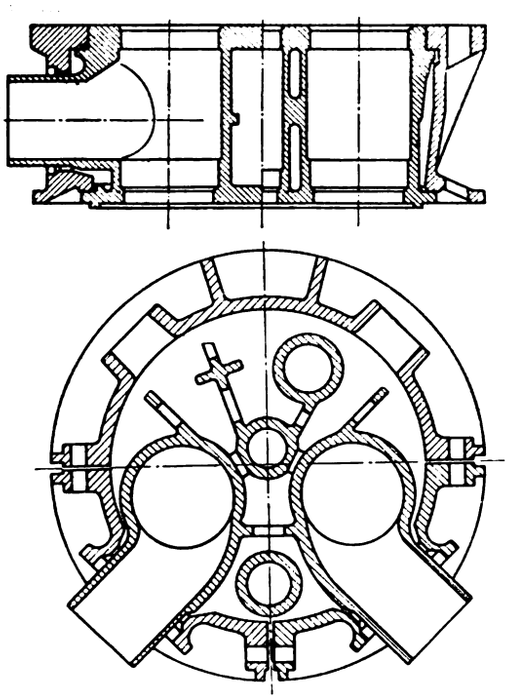

Fig. 26.—Deutsche Werke cylinder cover

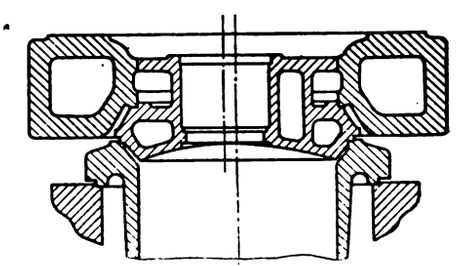

Fig. 27.—Two-piece cylinder cover

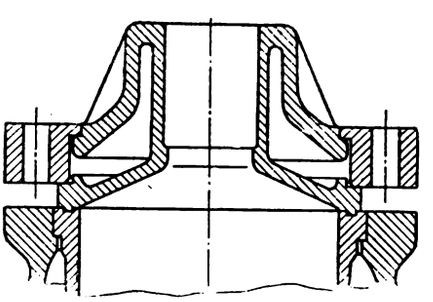

Fig. 28.—Two-piece cylinder cover

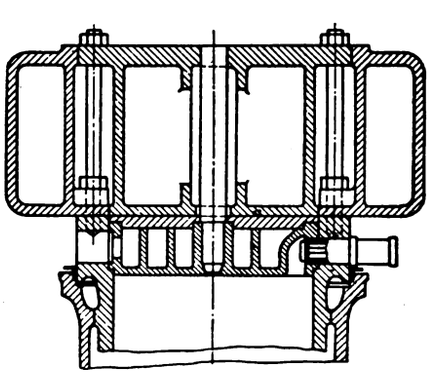

Fig. 28a.—Built-up cylinder cover

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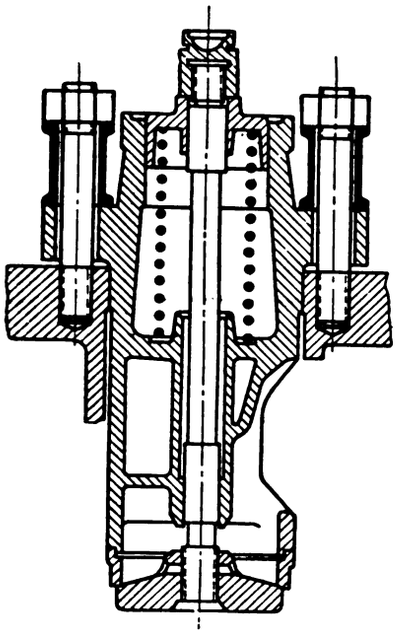

Fig. 29.—Modern valve design

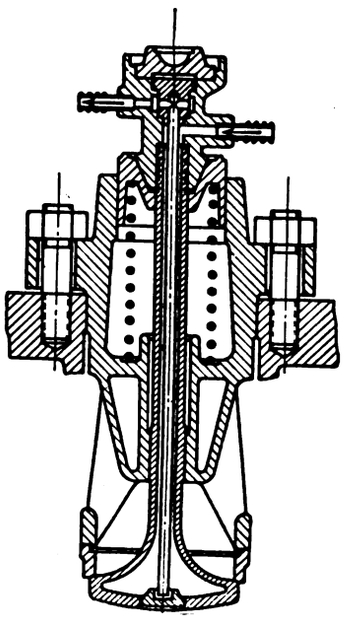

Fig 30.—Old valve design

Frequently the inner and outer parts are kept distinct in order to allow of a better expansion of the inner part and also to realize a higher water speed (Figs. 27, 28 and 28a). For greater strength present practice favors cast steel for these parts.

VALVES

Apart from the fuel valve, cover valves have not undergone any serious change. Water cooling once applied to the exhaust valves is now discontinued. Hollow mild steel valves cannot resist the exhaust gases so well as cast iron valve washers. Fig 30 shows the old and Fig. 29 shows the new design. With large engines the expansion of the valve casing due to heat introduces difficulties. The casing stretches and strips the connecting bolts. In order to make the expansion of no consequence, spring washers or thin flexible sleeves are placed under the nuts as shown in Figs. 29 and 31. Present practice also is to keep the valves high, resulting in a simpler cover and more accessible and external valve springs (Fig. 32).

Formerly Messrs. Sulzer, for example, used mechanically operated valves for the scavenge air of their two stroke engines, but now adopt a slide valve gear. More recently automatic valves are being adopted. Other scavenge methods will not be here further discussed since these have been the subject of quite a number of recent publications. Valve scavenging almost universally adopted before the war is now seldom used and has largely given place to port scavenging with its resulting simplification of engine design.

STARTING AND REVERSING GEAR

The cam shaft in single acting engines is placed either above or about half height of the engine. The first practice has generally been preferred by German designers since it admits of simple shaft gear.

When the cam shaft is placed at half height the valves are operated by striking rods. Practically no other method has been adopted in marine oil engines during their period of development. The cam shaft originally was almost exclusively driven by screw gearing. However even with well-cut gears of ample size, difficulties arise and particularly if the engine is working in a critical revolutions range heavy wear of the gear teeth produced by point contact is occasioned. Gear wheels also have the further disadvantage that they are difficult to replace abroad, a fact which is of definite importance in vessels trading for long periods in foreign waters. Endeavors have thus been made to evolve a simpler type of cam shaft drive and various alternatives have been put forward.

Bevel wheels in conjunction with spur wheels were probably the first alternative to be adopted (Fig. 33). With the cam shaft at half height, frequently only spur wheels are used (Fig. 34). A few builders have, however, adopted a

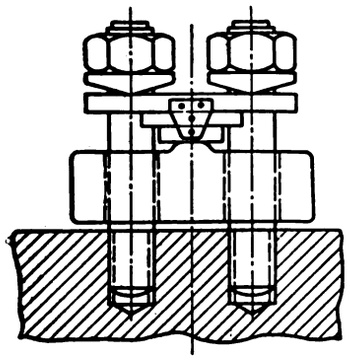

Fig. 31.—Valve connection

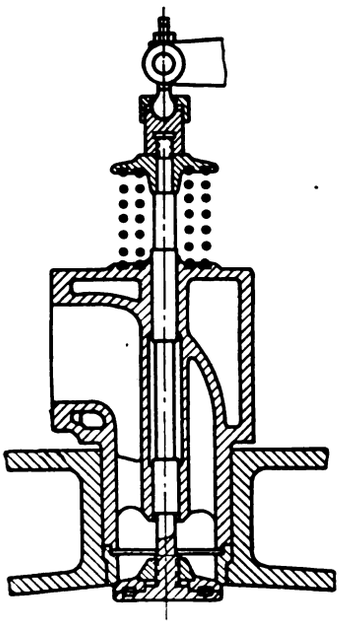

Fig. 32.—External spring valve

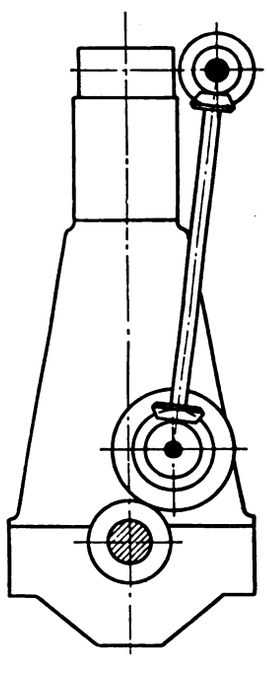

Fig. 33.—Bevel and spur wheel cam shaft drive

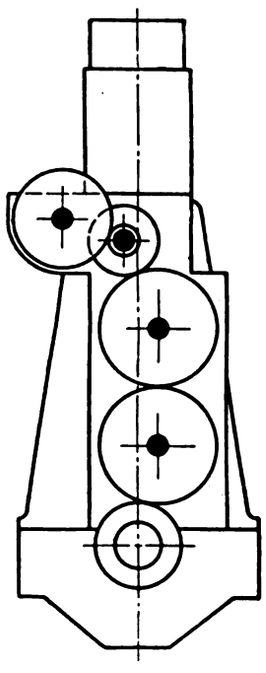

Fig. 34.—Simple bevel wheel cam shaft drive

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rod drive. With four strokes one pair of wheels is still necessary in order to effect a 2 to 1 transmission. The rod drive has the advantage that all rubbing parts only require the use of a simple pin and journal. The journals can easily be adjusted by the engine staff and, if necessary, new white metal can be run in, thereby admitting of repair at sea (Fig. 35). In the arrangement shown in Fig. 35 the small upper crank shaft, driven outwards from below, is directly supported from the bed plate by suitable cylindrical

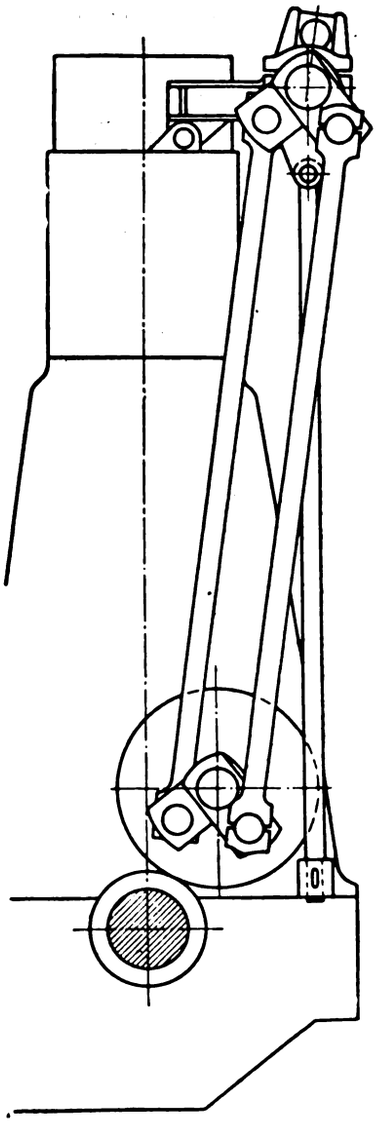


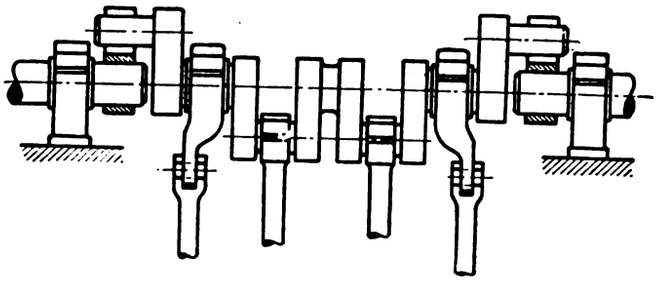
Fig. 35.—Coupling rod cam shaft drive

columns. The main engine expansion does not therefore interfere with the running of the rod drive.

In the latest compressorless engines with port scavenging, the cam shaft can be entirely eliminated since a continuous control of the fuel valve is no longer necessary and the starting valve can easily be operated by some type of telegear.

Reversal, therefore, before the war was accomplished essentially by two methods, the cam shaft either being displaced axially after the lever has lifted from the cam or, in two strokes, by a rotation of the cam shaft. In this latter case no special cams for ahead or astern are fitted. In four strokes cam shaft displacement is still frequently adopted, while Messrs. Sulzer in their two strokes use a non-displacing, non-rotating shaft having distinct cams for ahead and astern. Reversal is accomplished by the manipulation of a rocking lever carrying offset rollers.

Before the war, lubrication followed steam practice, the crank pit being open in order to obtain complete accessibility and visibility of working parts in case of imminent lubricating or cooling defects. It was soon found that lubrication involved much greater attention than with the steam engine and especially the crosshead guides. The forced lubrication system is therefore now generally



adopted, the oil being fed through the main bearings. This system has been found very satisfactory. For smooth working it is essential that the oil be thoroughly filtered in order to keep out foreign matter and further that the oil feed pipes be of ample size. A manometer is necessary in the pressure lead of the lubricating oil pump and the engine staff should periodically examine the bearings and clean the filter. Actually however their work is appreciably less than with the steam engine.

In single acting two strokes the oil pressure at the crosshead pin should either be kept particularly high or a separate pump provided. Forced lubrication naturally requires the bed plate to be completely tight to avoid leakage. It must thus be constructed with great care.

Cooling

Present practice favors the use of the highest possible cooling medium speeds. In the cylinders and particularly cylinder covers, deposits left by salt water cooling have led to considerable trouble. In vessels having to pass estuaries where the water is very muddy the use of fresh water cooling is preferable. The recooling of the cooling water presents no difficulty since, and especially with centrifrugal circulating pumps, the water is not contaminated by oil.

It was once thought that the pistons should also be fresh water cooled and cylinders sea water cooled. It was found that fresh water piston cooling has its difficulties, oil leaking into the water, being deposited in the return-cooler, thus effecting the recooling of the water. An oil deposit is also found in the piston itself thus making cooling more difficult. With sea water the water is continually being changed so that the above difficulties do not occur. It has also been found that the rapid motion of the piston prevents the occurrence of encrustation due to the use of salt water. With the recent adoption of cast steel for the pistons of double acting two strokes, a return is being made to fresh water cooling, greater care now being taken to avoid oil leakage into the cooling water.

With four strokes, where much less heat requires to be led away in the cooling water and where the difficulty of securing tight cooling water leads is much greater, water is very rarely used, oil being preferred.

Examinations for Marine Engineer.—Applications for examination to fill vacancies as first assistant marine engineer in the Coast and Geodetic Survey at $150 to $170 a month may be filed with the Civil Service Commission at Washington, D. C., not later than March 15.

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Progress in Economy of Turbine Machinery on Land and Sea*

By Sir Charles A. Parsons, R. J. Walker and Stanley S. Cook

THE steam turbine began its history in competition with the reciprocating steam engine. The same laws of steam held for both and, working between the same limits, the same energy per pound of steam was available. There was, however, a fundamental difference in the method of its utilization, the pressure energy of the steam being in the turbine converted stage by stage into velocity energy first, and thereafter into mechanical energy. The turbine, however, because of its being able to utilize the last stages of the expansion range, and to expand the steam down to the enormous specific volume which prevailed with a high condenser vacuum, was enabled to realize much greater thermal efficiencies and to surpass in economy the reciprocating engine.

This advantage, together with the fact that it was a rotary engine giving a uniform turning moment, enabled the turbine rapidly to take first place as a prime mover.

The turbine having established its superiority on land, its applicability for marine propulsion was demonstrated by the experiment carried out in the *Turbinia* in 1897.

Table I is a list of a few turbine vessels of historical interest which may be used to illustrate the trend of progress in economy during the last 25 years.

TABLE I

Date	Name	Type of drive	S.H.P.	Boiler pressure	Steam Consumption, lb. per s.h.p. hour
1897	*Turbinia*	Direct	2,100	150	
1901	*King Edward*	Direct	3,500	150	18.0 all purposes (s.h.p. estimated)
1906	*Lusitania*	Direct	68,000	195	13.0 turbines only
1914	*Aquitania*	Direct	60,000	195	12.0 turbines only
1908	*Otaki*	Combination	7,000	200	13.7 all purposes (s.h.p. taken same as i.h.p. of sister vessel)
1909	*Vespasian*	Geared S.R.	1,050	150	13.0 turbines only
1913	*Mahanada*	Geared S.R.	3,600	180	11.3 turbines only
1919	*Cairnross*	Geared D.R.	3,200	190	9.0 turbines only (200° F. superheat)
1922	*Orama*	Geared S.R.	19,000	215	9.25 turbines only (150° F. superheat)
1919	*Conte Rosso*	Geared D.R.	20,000	200	10.0 turbines only (saturated)
1898	*Viper*	Direct	11,000	250	
1904	*Eden*	Direct	7,000	250	
1904	*Amethyst*	Direct	15,000	260	14.6 turbines only (s.h.p. estimated)
1906	*Dreadnought*	Direct	26,000	250	14.3 turbines only
1906	Battleships	Direct	43,000	235	12.2 turbines only
1913	Battleships	Direct	30,000	235	13.2 turbines only
1919	Battleships	Direct	70,000	250	11.8 turbines only

From 1904 onward until 1910 improvements in efficiency resulted from increase of output and higher velocity ratios, where the speed of revolutions permitted it without undue increase of dimensions. The efficiency obtained depended, however, very much upon the class of vessel, since the turbine revolutions were the same as those of the propeller. Under the conditions which were thus imposed the highest efficiency attained in any directly coupled marine turbine was represented by a steam consumption for turbines only of 11.8 pounds per shaft horsepower hour with saturated steam at about 250 pounds per square inch. In the *Mauretania* and *Lusitania* the steam consumption was 13.0 pounds per shaft horsepower hour for turbines only, while the *Aquitania*, with her two high pressure turbines taking the steam in series, achieved 12 pounds per shaft horsepower hour.

In 1908, to widen the field of application to vessels of moderate speed, a combined system was adopted in which the expansion of the steam exhausting from a reciprocating engine was continued in a low pressure turbine. In machinery of this type, the addition of the low pressure turbine effected an economy of coal consumption over that obtained by triple expansion engines alone, of about 14 percent.

These early results are of interest as reflecting how greatly the marine turbine was handicapped by its direct association with the propeller that it drove. The change to mechanical gearing in 1910 removed that handicap and inaugurated a new era of turbine efficiency for marine work.

The improvement in the steam consumption in mercantile vessels fitted with geared turbines is seen from Table I, the lowest figure which has been accurately recorded being that of the *Cairnross*. The installation in this vessel was of the type now recognized as the most efficient of modern arrangements, consisting of three or more turbines in series grouped round a common gear wheel, through which their power is transmitted to the propeller shaft.

A good example of a modern geared turbine arrangement is that which was fitted in the twin screw Orient liner *Orama*, built by Messrs. Vickers, Ltd., in 1924. Each set consisted of three turbines geared by single reduction to the propeller shaft with three pinions gearing into a common wheel. Special attention was paid in this installation, not only to the efficiency of the main turbines, but also to economy in the fuel consumption for the auxiliary machinery, with the result that an overall fuel consumption was obtained of .785 pound of oil fuel per shaft horsepower hour for all purposes.

The figures in the table do not represent the whole of the improvement in economy effected by the introduction of gearing, since with gearing the propeller efficiency has been increased.

The advantages of gearing were not, however, confined to the vessels of slow and moderate speed, for which it was primarily intended. Its use soon became general for fast cross-channel steamers and even in high-speed war vessels, leading to improved economy both at full power and at cruising speed as well as increased facility of overhaul on account of the smaller size of the turbine units. With the use of additional cruising stages, it has been estimated that the cruising radii of naval vessels have been increased by some 40 percent owing to the introduction of mechanical gearing.

* From a paper read before the North East Coast Institution of Engineers and Shipbuilders, January, 1927.

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TABLE II

Date	Destination	Full Load kw.	R.P.M.	Steam pressure lb. per sq. in.	Steam Temperature, ° F.	Exhaust Vacuum (Bar. 30in.).	Steam Consumption lb./kw.h.	Heat Consumption B.T.U./ kw.h.	Remarks
1884	....	4	18,000	60	308	.....	200	201,000	NonCondensing.
1886	Newcastle-on-Tyne	75	4,800	100	338	.....	55	55,770	NonCondensing.
1892	Cambridge	100	4,800	100	388	27.00	27	30,750	First Condensing.
1900	Elberfeld ..	1,000	1,500	150	480	28.40	18.22	22,000	Tandem Cylinders.
1907	Carville	5,000	1,200	200	508	29.00	13.19	16,200	Single-cylinder
1912	Chicago	20,000	750	200	588	29.00	10.42	13,250	Tandem Cylinders
1918	Carville	10,000	2,400	250	706	29.00	10.05	13,390	Tandem Cylinders
1922	Barking	15,000	3,000	350	700	29.00	9.49	12,560	Tandem Cylinders
1922	Barking	35,000	3,000	350	700	29.00	*8.15	*10,750	Cross Compound. Reheating after H.P. cylinder to 700° F., and feed water heating to 250° F.
1923	Chicago	50,000	1,800 H.P. 1,800 I.P. 720 L.P.	550	750	29.25	*8.38	*10,265	Reheating after H.P. cylinder to 700° F., and feed water heating to 315° F.

*With feed heating and reheating.

Table II gives instances of turbines driving electric generating plant, for which accurate measurements as regards steam consumption have been available. The table affords an indication of the rapidity of progress in these directions.

The consumptions in the table are given in terms of kilowatt-hours of electrical output. The corresponding figures for consumption per shaft horsepower at the coupling would be about 7/10 of these figures.

It will be seen that the improvements made in land turbines in recent years have been largely due to increased steam pressures and superheat as well as higher vacua. Turbine efficiencies have been increased by the extended use of end tightened blading, thereby diminishing the leakage losses, and overall thermal efficiency further increased by "Cascade" feed heating.

As regards the advantages of higher pressures, the higher the initial pressure and the lower the back pressure, the greater is the range of expansion available to the turbines, and the greater therefore the energy available for conversion into work.

Theoretically to obtain the maximum efficiency, a heat engine must receive all its heat at the highest temperature and reject it to the lowest, an ideal which seems impossible of complete attainment in any practicable engine. In the steam engine, for example, heat is imparted to the working fluid at a variety of temperatures; first, the water is raised from the temperature of condensation to boiling point temperature; secondly, it is evaporated at that temperature and thirdly, after evaporation, its temperature is raised by superheating to the maximum value. In the internal combustion engine, when gas is heated by combustion, heat is imparted at either constant volume or at constant pressure, or under conditions intermediate between these two, in any case at a gradually increasing temperature. In the steam engine, however, the property of latent heat does enable us by means of the condenser to attain the ideal as regards rejection of the heat uniformly at the lowest possible temperature, while the same property enables us to raise the temperature at which the major portion of the heat is received, by raising the boiler pressure, and in consequence the temperature of evaporation.

The use of mechanical gearing having enabled turbines in marine propulsion to be designed with the maximum efficiency of conversion of the available energy of the steam, following the lead of land turbines it is now being sought to realize the considerable improvement which is attainable on further increasing the available energy per pound of steam, by the use of higher steam pressure and temperature and by regenerative heating of the feed water by previously expanded steam.

For higher pressures it is necessary to adopt watertube boilers. This type of boiler has been extensively used for naval work, and in some of the largest Atlantic liners, and will operate successfully over a long life provided that suitable precautions are taken to keep the feed water clean and free from salt. There are several vessels now under construction with watertube boilers and high steam pressure.

Since economy in total fuel consumption is the ultimate aim, while the highest efficiency of conversion of heat into power is necessary on the part of the main engines that propel the vessel, careful choice must also be made of the type of machinery for driving the auxiliaries, and in some recent installations the auxiliaries are driven by electric motors with current supplied either from turbo-generators or Diesel generators.

With auxiliaries driven by steam reciprocating engines, it is the usual practice to utilize the exhaust steam to heat the feed water to a temperature of about 200 degrees F. With electrically driven auxiliaries, there may be no exhaust steam available, in which case it is best to heat the feed water in surface heaters by steam withdrawn from the main turbines at suitable pressures.

Table III has been prepared to show as closely as possible the overall result that may be expected with an installation of high-pressure turbines, under the following four different methods of driving auxiliaries:

(1) Entirely by steam.

(2) Electric motors, with current supplied from turbo-generators.

(3) Electric motors, with current supplied from Diesel generators.

(4) Mechanically from the main engines, with the provision of suitable "stand-bys."

TABLE III.—EVALUATION OF OIL-FUEL CONSUMPTIONS OF 5,000 S.H.P. INSTALLATION.

Conditions:

Initial pressure .....500 lb. per square inch (absolute).
Initial temperature .....750° F.
Condenser vacuum .....29 in. mercury (Bar 30").
B.T.U. per lb. of oil.....18,500.
Boiler efficiency .....84 percent.

	1 Steam-driven Auxiliaries A	1 Steam-driven Auxiliaries B	2 Steam-Electric Auxiliaries	3 Diesel-Electric Auxiliaries	4 Auxiliaries Driven from Main Engines
Turbine steam .....(lb./hr.)	36,000	36,000	36,000	36,000	36,000
Total steam for auxiliaries. (lb./hr.)	8,960	8,960	7,650	2,450	2,450
Available for feed-heating. (lb./hr.)	7,210	7,210	5,900	850	850
Utilized for feed-heating. (lb./hr.)	5,800	5,800	5,700	4,950	4,950
Utilized in L.P. turbine.. (lb./hr.)	.....	1,410	.....	.....	.....
Increase of s.h.p.	.....	98	.....	.....	.....
Tapped off from L.P. turbine, (lb./hr.)	.....	.....	.....	4,100	4,100
Decrease of s.h.p.	.....	.....	.....	285	285
H.P. absorbed by auxiliary machinery in (4)	.....	.....	.....	.....	132
S.H.P. for propeller shaft.....	5,000	5,098	5,000	4,715	4,583
Total steam .....(lb./hr.)	44,960	44,960	43,650	38,450	38,450
Oil for steam production.. (lb./hr.)	3,405	3,405	3,310	2,910	2,910
Oil for Diesel generator.. (lb./hr.)	.....	.....	.....	82.5	.....
Total oil .....(lb./hr.)	3,405	3,405	3,310	2,992.5	2,910
Lb. oil per S.H.P. hour at 215 degrees F. feed temperature.	0.681	0.668	0.662	0.635	0.635
Lb. oil per S.H.P. hour at 310 degrees F. feed temperature.	0.667	0.655	0.648	0.62	0.62

The installation of main machinery to which this calculation applies is that of a single-screw cargo vessel of 5,000

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shaft horsepower with an admission pressure of 500 pounds per square inch, initial temperature of 750 degree F., condenser vacuum 29 inches Hg., and assumed boiler efficiency 84 percent. Additional feed heating to a temperature of 310 degrees F. is effected by steam tapped off from the main turbines at a suitable high pressure stage.

Summarized, the resulting values for oil fuel consumed per shaft horsepower hour are as follows:

Proposal 1, with steam driven auxiliaries, 0.667 pounds.

Proposal 2, with motor driven auxiliaries and turbo-generators 0.648 pounds.

Proposal 3, with motor driven auxiliaries and Diesel generators, and for Proposal 4, with auxiliary machinery mechanically driven from the main engine, 0.62 pound.

A pioneer installation of high pressure machinery was fitted last year in the Clyde steamer *King George V.*, having a power of 3,500 shaft horsepower on two shafts, a boiler pressure of 550 pounds per square inch, and the steam superheated to 750 degrees F. It will be clear that the economical effect of adopting high pressures would have been considerably greater in an installation of larger power. The experiment on this vessel, however, was not only made in order to demonstrate a higher efficiency, but to explore the practical application of high temperatures and watertube boilers to marine work, and also to ascertain what practical difficulties, if any, had to be overcome in this connection.

The propelling machinery* consists of a set of three turbines, geared by single reduction to each propeller shaft, such as has been frequently adopted in previous geared turbine installations, but in this vessel one additional high pressure turbine is fitted to utilize the expansion of the steam from 550 pounds to about 200 pounds.

The total shaft horsepower developed on the two shafts is 3,500 at a speed of 570 revolutions per minute for the propellers. The high pressure turbine and the two intermediate pressure turbines of each shaft run at 6,000 revolutions per minute and the low pressure turbine at 3,000 revolutions per minute. Of the total power the high pressure turbine contributes about 600 shaft horsepower.

The ahead blading is of the reaction type throughout, and at the high pressure end the blades are of necessity short. Leakage, however, is minimized by the use of end-tightened blading in the high pressure turbine and in the two intermediate pressure turbines of each side.

In view of the high temperature of the steam, monel metal is used for the blading of the high pressure ahead turbine and the first and second intermediate pressure turbines on each side. The astern impulse blades are also of monel metal. Cast steel is used for all parts of the casing subject to high temperature.

There are two condensers on each side of the vessel connected with the turbines by sub-divided exhaust branches. These are fitted with flap valves so that any one of the four condensers can be isolated from the system and opened out for examination in the event of failure of the condenser tubes. Each condenser can also be isolated on the water sides so that, if necessary, a repair can be executed without stopping the machinery, or appreciably reducing the speed of the vessel. The object of this provision is to safeguard the system against entry of salt into boilers.

All high pressure steam pipes are of solid drawn steel, tested to three times their working pressure. The flanges are screwed on to the ends of the pipes with a vanishing thread and the end of the thread at the face of the flange sealed by electric welding. The joint is made metal to metal, with bolts of large diameter having a plus thread.

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The boilers are coal burning, two in number, of the Yarrow watertube type, designed for a working pressure of 550 pounds per square inch with superheater elements to raise the temperature of the steam to a maximum temperature of 750 degrees F., surface air heaters in the uptakes to heat the air on its way to the grates, and a closed stokehold system of forced draft.

In order to limit the variants as far as possible to the main engines and boilers, the auxiliary machinery is of the usual type. The steam for the auxiliary engines is taken from the superheated steam drum through an internal pipe in the saturated steam drum, by which means its temperature is reduced. Thence it is led through a reducing valve and supplied to the auxiliary steam range at a pressure of 200 pounds per square inch and a temperature about 450 degrees F., being thus only slightly superheated.

These engines exhaust at a pressure of 5 pounds per square inch above atmospheric and the exhaust steam is condensed in a feed heater of the surface type, thereby raising the temperature of the feed water to about 200 degrees F. It then passes to an additional high pressure feed heater utilizing steam tapped off from the turbines which raises its temperature to about 300 degrees F.

After the completion of the builder's trials, in which the specified speed and power were easily fulfilled, the *King George V* was put immediately on service on the Clyde, and ran regularly for three weeks to the end of the season. The vessel was then placed at the disposal of the builders for consumption trials. Calibrated measuring tanks were placed on deck, and connections made in such a way that a measurement could be taken both of the steam consumption of the turbines only and of the auxiliaries simultaneously.

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Total shaft horsepower	3,489	2,800	2,083
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L.P. exhaust temp.	87°	85°	81°
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Temp. circulating inlet	49° F.	48° F.	49° F.
Temp. circulating discharge	69°	66°	66°
Circulating pump, revs./min.	362	354	303
Air pump, D.S./min.	33.6	34.86	28.7
Feed pump, D.S./min. P.	13.4	11.5	8.7
Feed pump, D.S./min. S.	7.7	7.2	6.5
Forced lub. pump, D.S./min. F.	25.6	21.0	22.9
Forced lub. pump, D.S./min. A.	8.6	5.9	6.3
F.D. fan engine, revs./min.	397	....	334
Dynamo, volts-amps.	110-100	110-101	110-102
Mean temp. of engine room	90°	91°	87°
L.F. feed heater discharge	212°	....	212°
Water Consumption.			
Turbines, lb./s.h.p./hour	8.01	8.38	8.72
Auxiliaries, lb./s.h.p./hour	1.66	1.86	2.21
All purposes, lb./s.h.p./hour	9.67	10.24	10.93
Coal consumption, lb./s.h.p./hour	1.085	....	1.17
Boiler efficiency	79%	....	80%

The coal used in these trials was ordinary Scotch "Polmaise," as used for service of these vessels. Its gross calorific value was determined as 13,880 B.T.U. per lb.

It should be observed that these figures agree closely with the results anticipated for this vessel, bearing in mind the small power per shaft and the shortness of the blades of the high pressure and first intermediate turbines, and confirm that in larger powers the gain of efficiency claimed for higher pressures and temperatures will be obtained. Further, the experiment has shown that there are no difficulties in the way of such installations which cannot be met by suitable provision.

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TABLE II

Date	Destination	Full Load kw.	R.P.M.	Steam pressure lb. per sq. in.	Steam Temperature, ° F.	Exhaust Vacuum (Bar. 30in.).	Steam Consumption lb./kw.h.	Heat Consumption B.T.U./kw.h.	Remarks
1884	....	4	18,000	60	308	.....	200	201,000	NonCondensing.
1886	Newcastle-on-Tyne	75	4,800	100	338	.....	55	55,770	NonCondensing.
1892	Cambridge	100	4,800	100	388	27.00	27	30,750	First Condensing.
1900	Elberfeld ..	1,000	1,500	150	480	28.40	18.22	22,000	Tandem Cylinders.
1907	Carville	5,000	1,200	200	508	29.00	13.19	16,200	Single-cylinder
1912	Chicago	20,000	750	200	588	29.00	10.42	13,250	Tandem Cylinders
1918	Carville	10,000	2,400	250	706	29.00	10.05	13,390	Tandem Cylinders
1922	Barking	15,000	3,000	350	700	29.00	9.49	12,560	Tandem Cylinders
1922	Barking	35,000	3,000	350	700	29.00	*8.15	*10,750	Cross Compound. Reheating after H.P. cylinder to 700° F., and feed water heating to 250° F.
1923	Chicago	50,000	1,800 H.P. 1,800 I.P. 720 L.P.	550	750	29.25	*8.38	*10,265	Reheating after H.P. cylinder to 700° F., and feed water heating to 315° F.

*With feed heating and reheating.

Table II gives instances of turbines driving electric generating plant, for which accurate measurements as regards steam consumption have been available. The table affords an indication of the rapidity of progress in these directions.

The consumptions in the table are given in terms of kilowatt-hours of electrical output. The corresponding figures for consumption per shaft horsepower at the coupling would be about 7/10 of these figures.

It will be seen that the improvements made in land turbines in recent years have been largely due to increased steam pressures and superheat as well as higher vacua. Turbine efficiencies have been increased by the extended use of end tightened blading, thereby diminishing the leakage losses, and overall thermal efficiency further increased by "Cascade" feed heating.

As regards the advantages of higher pressures, the higher the initial pressure and the lower the back pressure, the greater is the range of expansion available to the turbines, and the greater therefore the energy available for conversion into work.

Theoretically to obtain the maximum efficiency, a heat engine must receive all its heat at the highest temperature and reject it to the lowest, an ideal which seems impossible of complete attainment in any practicable engine. In the steam engine, for example, heat is imparted to the working fluid at a variety of temperatures; first, the water is raised from the temperature of condensation to boiling point temperature; secondly, it is evaporated at that temperature and thirdly, after evaporation, its temperature is raised by superheating to the maximum value. In the internal combustion engine, when gas is heated by combustion, heat is imparted at either constant volume or at constant pressure, or under conditions intermediate between these two, in any case at a gradually increasing temperature. In the steam engine, however, the property of latent heat does enable us by means of the condenser to attain the ideal as regards rejection of the heat uniformly at the lowest possible temperature, while the same property enables us to raise the temperature at which the major portion of the heat is received, by raising the boiler pressure, and in consequence the temperature of evaporation.

The use of mechanical gearing having enabled turbines in marine propulsion to be designed with the maximum efficiency of conversion of the available energy of the steam, following the lead of land turbines it is now being sought to realize the considerable improvement which is attainable on further increasing the available energy per pound of steam, by the use of higher steam pressure and temperature and by regenerative heating of the feed water by previously expanded steam.

For higher pressures it is necessary to adopt watertube boilers. This type of boiler has been extensively used for naval work, and in some of the largest Atlantic liners, and will operate successfully over a long life provided that suitable precautions are taken to keep the feed water clean and free from salt. There are several vessels now under construction with watertube boilers and high steam pressure.

Since economy in total fuel consumption is the ultimate aim, while the highest efficiency of conversion of heat into power is necessary on the part of the main engines that propel the vessel, careful choice must also be made of the type of machinery for driving the auxiliaries, and in some recent installations the auxiliaries are driven by electric motors with current supplied either from turbo-generators or Diesel generators.

With auxiliaries driven by steam reciprocating engines, it is the usual practice to utilize the exhaust steam to heat the feed water to a temperature of about 200 degrees F. With electrically driven auxiliaries, there may be no exhaust steam available, in which case it is best to heat the feed water in surface heaters by steam withdrawn from the main turbines at suitable pressures.

Table III has been prepared to show as closely as possible the overall result that may be expected with an installation of high-pressure turbines, under the following four different methods of driving auxiliaries:

(1) Entirely by steam.

(2) Electric motors, with current supplied from turbo-generators.

(3) Electric motors, with current supplied from Diesel generators.

(4) Mechanically from the main engines, with the provision of suitable "stand-bys."

TABLE III.—EVALUATION OF OIL-FUEL CONSUMPTIONS OF 5,000 S.H.P. INSTALLATION.

Conditions:

Initial pressure .....500 lb. per square inch (absolute).
Initial temperature .....750° F.
Condenser vacuum .....29 in. mercury (Bar 30").
B.T.U. per lb. of oil.....18,500.
Boiler efficiency .....84 percent.

	1 Steam-driven Auxiliaries A	1 Steam-driven Auxiliaries B	2 Steam-Electric Auxiliaries	3 Diesel-Electric Auxiliaries	4 Auxiliaries Driven from Main Engines
Turbine steam .....(lb./hr.)	36,000	36,000	36,000	36,000	36,000
Total steam for auxiliaries. (lb./hr.)	8,960	8,960	7,650	2,450	2,450
Available for feed-heating. (lb./hr.)	7,210	7,210	5,900	850	850
Utilized for feed-heating. (lb./hr.)	5,800	5,800	5,700	4,950	4,950
Utilized in L.P. turbine. (lb./hr.)	.....	1,410	.....	.....	.....
Increase of s.h.p.	.....	98	.....	.....	.....
Tapped off from L.P. turbine. (lb./hr.)	.....	.....	.....	4,100	4,100
Decrease of s.h.p.	.....	.....	.....	285	285
H.P. absorbed by auxiliary machinery in (4)	.....	.....	.....	.....	132
S.H.P. for propeller shaft.....	5,000	5,098	5,000	4,715	4,583
Total steam .....(lb./hr.)	44,960	44,960	43,650	38,450	38,450
Oil for steam production. (lb./hr.)	3,405	3,405	3,310	2,910	2,910
Oil for Diesel generator. (lb./hr.)	.....	.....	.....	82.5	.....
Total oil .....(lb./hr.)	3,405	3,405	3,310	2,992.5	2,910
Lb. oil per S.H.P. hour					
at 215 degrees F. feed temperature.	0.681	0.668	0.662	0.635	0.635
at 310 degrees F. feed temperature.	0.667	0.655	0.648	0.62	0.62

The installation of main machinery to which this calculation applies is that of a single-screw cargo vessel of 5,000

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shaft horsepower with an admission pressure of 500 pounds per square inch, initial temperature of 750 degree F., condenser vacuum 29 inches Hg., and assumed boiler efficiency 84 percent. Additional feed heating to a temperature of 310 degrees F. is effected by steam tapped off from the main turbines at a suitable high pressure stage.

Summarized, the resulting values for oil fuel consumed per shaft horsepower hour are as follows:

Proposal 1, with steam driven auxiliaries, 0.667 pounds.

Proposal 2, with motor driven auxiliaries and turbo-generators 0.648 pounds.

Proposal 3, with motor driven auxiliaries and Diesel generators, and for Proposal 4, with auxiliary machinery mechanically driven from the main engine, 0.62 pound.

A pioneer installation of high pressure machinery was fitted last year in the Clyde steamer *King George V.*, having a power of 3,500 shaft horsepower on two shafts, a boiler pressure of 550 pounds per square inch, and the steam superheated to 750 degrees F. It will be clear that the economical effect of adopting high pressures would have been considerably greater in an installation of larger power. The experiment on this vessel, however, was not only made in order to demonstrate a higher efficiency, but to explore the practical application of high temperatures and watertube boilers to marine work, and also to ascertain what practical difficulties, if any, had to be overcome in this connection.

The propelling machinery* consists of a set of three turbines, geared by single reduction to each propeller shaft, such as has been frequently adopted in previous geared turbine installations, but in this vessel one additional high pressure turbine is fitted to utilize the expansion of the steam from 550 pounds to about 200 pounds.

The total shaft horsepower developed on the two shafts is 3,500 at a speed of 570 revolutions per minute for the propellers. The high pressure turbine and the two intermediate pressure turbines of each shaft run at 6,000 revolutions per minute and the low pressure turbine at 3,000 revolutions per minute. Of the total power the high pressure turbine contributes about 600 shaft horsepower.

The ahead blading is of the reaction type throughout, and at the high pressure end the blades are of necessity short. Leakage, however, is minimized by the use of end-tightened blading in the high pressure turbine and in the two intermediate pressure turbines of each side.

In view of the high temperature of the steam, monel metal is used for the blading of the high pressure ahead turbine and the first and second intermediate pressure turbines on each side. The astern impulse blades are also of monel metal. Cast steel is used for all parts of the casing subject to high temperature.

There are two condensers on each side of the vessel connected with the turbines by sub-divided exhaust branches. These are fitted with flap valves so that any one of the four condensers can be isolated from the system and opened out for examination in the event of failure of the condenser tubes. Each condenser can also be isolated on the water sides so that, if necessary, a repair can be executed without stopping the machinery, or appreciably reducing the speed of the vessel. The object of this provision is to safeguard the system against entry of salt into boilers.

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The gearing is of the usual double-helical type, and consists of a wheel 54 inches diameter on each shaft with three pinions to each wheel.

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The boilers are coal burning, two in number, of the Yarrow watertube type, designed for a working pressure of 550 pounds per square inch with superheater elements to raise the temperature of the steam to a maximum temperature of 750 degrees F., surface air heaters in the uptakes to heat the air on its way to the grates, and a closed stokehold system of forced draft.

In order to limit the variants as far as possible to the main engines and boilers, the auxiliary machinery is of the usual type. The steam for the auxiliary engines is taken from the superheated steam drum through an internal pipe in the saturated steam drum, by which means its temperature is reduced. Thence it is led through a reducing valve and supplied to the auxiliary steam range at a pressure of 200 pounds per square inch and a temperature about 450 degrees F., being thus only slightly superheated.

These engines exhaust at a pressure of 5 pounds per square inch above atmospheric and the exhaust steam is condensed in a feed heater of the surface type, thereby raising the temperature of the feed water to about 200 degrees F. It then passes to an additional high pressure feed heater utilizing steam tapped off from the turbines which raises its temperature to about 300 degrees F.

After the completion of the builder's trials, in which the specified speed and power were easily fulfilled, the *King George V* was put immediately on service on the Clyde, and ran regularly for three weeks to the end of the season. The vessel was then placed at the disposal of the builders for consumption trials. Calibrated measuring tanks were placed on deck, and connections made in such a way that a measurement could be taken both of the steam consumption of the turbines only and of the auxiliaries simultaneously.

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High Pressures and Economy in Marine Machinery

While increases in superheat show consistent economy, increases in pressures beyond 300 pounds show little actual overall gain

By Captain H. C. Dinger, U. S. N.

AN interesting comparison of performance of economical power plants is given in Mr. Parson's paper, "Progress in Economy of Turbine Machinery on Land and Sea," presented before the North East Coast Institution of Engineers and Shipbuilders, published elsewhere in this issue. An analysis of the data given throws some light upon what may be expected from improved designs of marine machinery.

Barking Station, with 350 pounds pressure and 700 degrees F., gives a steam consumption of 8.15 pounds per kilowatt-hour and a heat consumption of 10,750 B.t.u., while Chicago, with 550 pounds and 750 degrees F., gives 8.38 and 10,265. Also, Chicago is the larger unit and has heated feed water up to 315 degrees F.; while Barking only heated to 250 degrees F. According to the advocates of high pressure, Chicago should have shown a considerably higher gain in economy than is here indicated. In fact, the increase in superheat of 50 degrees F. and the higher feed water temperature should have accounted for all the difference in the B.t.u. consumption. Hence, in this case, there is no appreciable gain by boosting the pressure from 350 to 550 pounds, although there would be a theoretical gain of about 3 percent.

Similarly, the improved economy of the *King George* over the *Orama* or *Cairnross* is accounted for by the increase in superheat. Here the *Cairnross,* with a pressure of 190 pounds and a steam temperature of 584 degrees F., gave a steam consumption (turbines only) of 9.0 pounds of water per shaft horsepower. The *Orama,* with 200 pounds pressure and 538 degrees F., gave 9.25, while the *King George,* with 520 pounds and 815 degrees F., obtained 8.01. The difference in temperature between the *Cairnross* and *King George* was 221 degrees F. and this, if properly used, is sufficient to account for the difference in steam consumption. The difference of temperature as between the *Cairnross* and *Orama,* 46 degrees F., also accounts for the difference in steam consumption between these vessels. Therefore, for marine work, with Parson's turbines, it appears that higher temperature invariably results in higher economy, but that higher pressures do not do this consistently. Furthermore, the fuel consumption of the *Orama* of 0.785, as compared with the equivalent of 0.725 for the *King George,* shows a total gain of 7.6 percent by raising the temperature 277 degrees F. and the pressure 305 pounds. Would not the increase in temperature and the two stage feed heating alone account for the gain in economy? These figures, taken from Mr. Parson's paper, appear to show that while the increase in superheat does show consistent economy, increases in pressures beyond 300 pounds show little actual overall gain. It would be interesting to know the results, if the *King George* were operated at 300 pounds instead of at 550. It is likely that there would be no difference if the initial temperatures were kept the same. This could be tried out and would serve to settle this matter of the practical gain of using higher pressures without increasing the temperatures.

For marine work, where it is difficult to provide proper economizers or air heaters and where proper heat insulation also is not easy, boiler efficiency cannot be kept as high with high pressures, on account of the increased losses in uptake gases and from radiation. These increased losses are sufficient to counteract most of the theoretical gain due to higher pressure after the point of 350 pounds (approximately) has been reached. A careful consideration of all that has been done, either on shore or afloat, appears to indicate that the most economical boiler pressure, on a dollar-and-cents basis, for marine boilers is not above 350 pounds. The most economical temperature is a more debatable matter, but indications are that anything above 600 degrees F. may initiate more adverse trouble than is compensated by the possible gains. By proper attention to the design of turbines, boilers, condensers and, in particular, to auxiliaries and stage heating, the economical results obtained by the *King George*—namely, the equivalent of 0.72 pound of oil per horsepower—can be bettered with an installation having 350 pounds pressure and 600 degrees F. steam temperature. Furthermore, if the *King George* were operated under these conditions, she would probably show an actual fuel and maintenance economy equal to that when operated at full pressure.

The higher pressure has an advantage in the reduction of the size of piping and high pressure parts, but this, again, is counterbalanced by the extra cost and weight, and also by the special design that is required. In the *King George* there was considerable trouble from unusual heat, which has been partially corrected by the application of more lagging and by additions and modifications to the ventilation system.

There is still a considerable field for saving by fully exploiting heat savers that do not require very high pressures, as has been done in the best paying power plants ashore. Marine condensers are susceptible to considerable improvement. Reheating by means of high pressure steam offers good possibilities for saving, while the full development of stage heating and the best use of all low level heat offers greater returns than does very high pressure. The proper selection and design of auxiliary machinery is another field where very considerable saving can be made. This is well brought out in Mr. Parson's paper; but, on the other hand, it will be noticed that on the *King George* the auxiliaries required 18 to 20 percent of the total steam. This is fairly high and by careful study could no doubt be improved. Mr. Parson states that the auxiliaries were of the usual type. It is believed that their steam consumption could be reduced by at least 25 percent by careful selection and design. It is apparent that, for steamships, the most suitable and economical procedure with regard to auxiliaries is to adopt a combination steam and electric drive, with the electricity furnished by an oil engine.

Auxiliary engines, remote, very small and which have rather intermittent service, should have electric drive, while those that are large, in constant use and located in the engine and boiler rooms, should be steam driven. A 5,000 shaft horsepower installation, with 350 pounds and 600 degrees F., made on the above basis, with a boiler efficiency of 87 percent (which is practically attainable with a pressure of 350 pounds but not attainable with a pressure of 500 pounds), can be made to give a performance of about 0.65 pound of oil per hour for all purposes. This is about

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all that the very high pressure plant can secure. While the high pressure of 500 pounds and above may have better theoretical possibilities, it also has increased uptake and radiation losses, and these neutralize the gains. Furthermore, the increased capital charges will about wipe out any small gain by fuel economy that the very high pressure and high superheat may give.

The high pressure plant will allow for somewhat more compact machinery and some slight reduction in weight. This, however, may be bought too dearly from a dividend paying point of view.

POSSIBLE TROUBLES

There are also certain other auxiliary matters that may be considered where 800 degrees F. and 550 pounds are in vogue. How about the lasting quality of (a) the superheater tubes, (b) the turbine blading and nozzles? Unless the steam going to the superheater is continually dry and the steam to the turbines is both dry and clean, trouble may be caused. Superheater tubes having intermittent service under high temperature are prone to trouble, due to any solid deposit and to oxidation from the inside. Solids carried over into the turbine, particularly when accompanied by very high temperature and intermittent use, are likely to cause corrosion and erosion in nozzles and blading. These troubles are found in high pressure shore plants to a considerable extent and conditions on board ship are such that they are likely to be aggravated. By great care on the part of the operators, they may be guarded against, but is priming likely to be always absent? A good part of the troubles of this nature may possibly be reduced by careful deaëration of the feed water. This is considered desirable with moderate pressures and temperatures, but appears quite essential where the high pressures and temperatures are employed. Air and salt water are two very pernicious and redoubtable antagonists to the full success of high pressure marine installations.

The argument that because certain power plants, operated at constant base loads, appear to find high pressures economical cannot be applied directly to ships where the power factor is necessarily of quite a different order. The margin of increased economy, due to pressures above 300 pounds, is not large and the increased capital charge, especially on an intermittently operated plant, such as a ship is bound to be, may easily wipe out all the possible advantage that may be gained.

The most economical machinery on a dollar-and-cents basis, throughout the life of the vessel, will have to be a compromise that will have to consider many practical elements, some of which are outside of engineering.

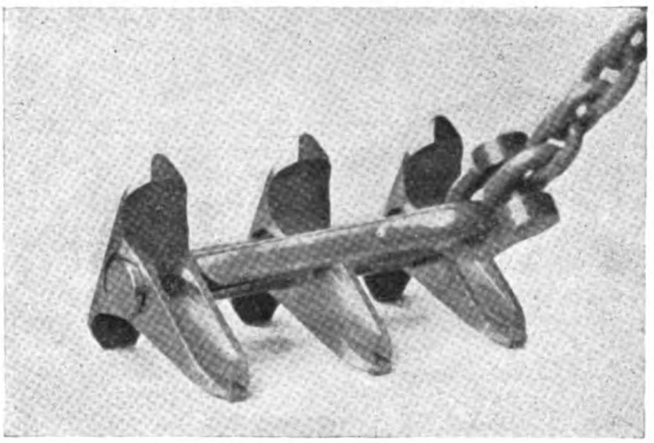
American Sailing Vessels Disappearing from the High Seas

THE day of the American sailing vessel is slowly passing, according to interesting information disclosed in Merchant Marine Statistics for 1926, just made public by the Department of Commerce. Where there were 635 sailing vessels of all classes under construction in 1798, today there remain but eleven.

In 1798 there were built 53 brigs, 401 schooners, 344 barks and barkentines and 147 sloops, while in 1926 there were constructed only 2 schooners and 9 sloops. The last brig was built in 1910 and the last of the barks and barkentines were constructed in 1921 when three ships of this class were placed on the high seas. The fast moving steam and motor driven vessels are replacing the much slower sailing vessels, according to statistics just made public by the government.

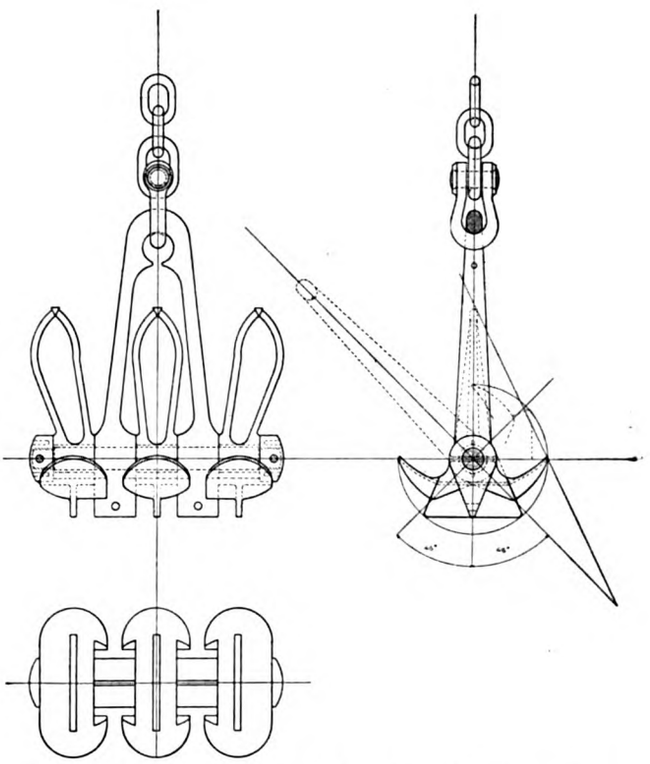
The Triple Fluke Anchor

THE novel type of stockless anchor illustrated has been patented by a former officer of the Swedish Navy. It is claimed that the new anchor with its three separate flukes has a much greater holding power than an ordinary



Triple fluke anchor

stockless anchor of the same weight. For equal holding power the triple fluke anchor weighs about 18 percent less than the old type. Furthermore, the reduced length of



Side and end elevations and plan of triple fluke anchor

the divided shank admits of a shorter and lighter hawsepipe.

PATENTED IN THE UNITED STATES

This anchor is covered by United States patents. Shop rights for its production may be arranged for by communicating with the inventor and patentee, Mr. Waldemar Stahlberger, Vegby, Sweden.

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Tests of Shipping Board Diesel Engines

Results of shop tests of first and second McIntosh and Seymour engines constructed for Shipping Board Diesel conversion program

SUMMARY OF SHOP TEST ON MCINTOSH AND SEYMOUR MARINE DIESEL ENGINES (FIRST ENGINE)

Date of tests—February 26 to March 28, 1926.
Location—Auburn, N. Y.
Builder—McIntosh and Seymour Corporation.
Type of engine—Four cycle, single acting.
Rated brake horsepower—2,700.
Number of working cylinders—6.
Diameter of working cylinders—32 inches.
Stroke of working cylinders—60 inches.
Diameter of compressor cylinders (3—3 stage).
Stroke of compressor cylinders.

Independent driven air compressor unit.
Four cycle trunk piston.
400.
4.
17 inches.
24 inches.
1st stage 17¼ inches, 2nd stage 15 inches, 3rd stage 3½ inches.
12 inches.

30 DAY TEST DATA AT FULL LOAD (FIRST ENGINE)

Duration—30 Days	Maximum	Minimum	Average
Barometer	30.69"	29.36"	29.96"
Pressure—injection air	1,006.5 lbs.	937.3 lbs.	979.4 lbs.
Pressure—jacket cooling water.	33.5 lbs.	22.0 lbs.	26.2 lbs.
Pressure—piston cooling water.	33.5 lbs.	22.0 lbs.	26.2 lbs.
Pressure—lubricating oil	10.8 lbs.	10.0 lbs.	10.3 lbs.
Temperature—Atmosphere	42.5° F.	11.5° F.	29.8° F.
Temperature—engine room	77.9° F.	63.0° F.	69.7° F.
Temperature—fuel oil	148.2° F.	125.4° F.	139.2° F.
Temperature—cooling water inlet	35.0° F.	35.0° F.	35.0° F.
Temperature—cooling water outlet	114.0° F.	113.8° F.	113.9° F.
Temperature—exhaust	738.0° F.	688.9° F.	718.5° F.
High heat value of fuel	18,926 B.t.u.	18,650 B.t.u.	18,780 B.t.u.
Low heat value of fuel*	17,829 B.t.u.	17,633 B.t.u.	17,706 B.t.u.
Viscosity (Sayholt Furol) at 77° F.	65 sec.	26 sec.	50.8 sec.
Baumé gravity at 60° F.	23.3	19.9	21.1
Sulphur content	3.06%	1.83%	2.53%
Flash point (Pensky-Martens).	220° F.	174° F.	197° F.
Burning point	247° F.	203° F.	225° F.
Fuel oil, lbs. per hour	1,293.0 lbs.	1,198.46 lbs.	1,255.89 lbs.
Fuel oil, lbs. per i.h.p. hour	.340	.321	.325
Fuel oil, lbs. per b.h.p. hour*	.440	.415	.428
Speed r.p.m.	95.71	95.11	95.39
Indicated horsepower	3,502.2	3,210.25	3,333.98
Mean indicated pressure	99.33 lbs.	91.62 lbs.	95.55 lbs.
Mean effective pressure	78.6 lbs.	76.8 lbs.	77.71 lbs.
Brake horsepower	2,720.56	2,703.5	2,711.50
Mechanical efficiency	83.46%	77.36%	81.37%
Thermal efficiency	33.31%	31.27%	32.14%

Duration—30 Days	Maximum	Minimum	Average
Pressure—injection air	1,077.9 lbs.	1,021.0 lbs.	1,059.1 lbs.
Pressure—jacket cooling water.	32.4 lbs.	25.0 lbs.	26.6 lbs.
Pressure—lubricating oil	13.0 lbs.	10.0 lbs.	11.2 lbs.
Temperature—Atmosphere	40.0° F.	11.5° F.	29.8° F.
Temperature—engine room	78.3° F.	60.2° F.	68.5° F.
Temperature—fuel oil	159.8° F.	139.2° F.	150.6° F.
Temperature—cooling water inlet	35.0° F.	35.0° F.	35.0° F.
Temperature—cooling water outlet	111.6° F.	98.8° F.	106.8° F.
Temperature—exhaust	705.1° F.	502.4° F.	659.2° F.
Speed r.p.m.	200	188.5	190.46
Indicated horsepower	564.5	463.73	525.76
Mean indicated pressure	108.0 lbs.	88.03 lbs.	100.38 lbs.
Brake horsepower	108.6	18.5	100.09
I.h.p. of air compressors	344.2	280.7	302.85

Brands Used and Consumption of Lubricating Oils

Engine Part	Brand	Drops Per Minute	Gallons Per 24 Hours	Total gals.
Power cylinders main engine.	Tursel Ex. Hy. Socony Grade B Socony Ex. Hy.	Each cyl. 65	2.45	consumed
Power cylinders compressor engine.	Tursel Ex. Hy. Socony Grade B	Each cyl. 8	1.62	per 24
Air compressor cylinders.	Tursel Ex. Hy. Heavy X	3 comp's 36	1.13	hours for
Forced feed.	Tursel Ex. Hy.		6.64	all purposes,
Hand feed.	Tursel Ex. Hy.		1.21	13.05 gals.

Number of Days Each Brand of Oil Was Used

Main Eng. Days	Comp. Days	Brand	Power Cyls. Main Engine	Power Cyls. Comp. Engine	Air Compressor	Force Feed
First 14	17-28	Tursel Ex. Heavy	X	X	X	Tursel ex.
3	13	Socony Grade B	X	X	..	heavy used
13	..	Socony Ex. Heavy	X	..	..	throughout
..	2	Heavy X	..	..	X	test.

* Heavy X Vacuum Oil Company. All others Standard Oil Company. Main engine was not shut down during entire thirty days' test, but operated without load during repairs on compressor unit, injection air being supplied by two auxiliary engines.

*Corrected to 18,500 B.t.u. and includes independent compressor unit plus b.h.p. carried on that unit.

All main engine parts were examined after the test and generally in very good condition except exhaust valve stems and piston rings. Some of the rings were found stuck in grooves and required freeing. This condition is attributed to high sulphur content of fuel in combination with sweat from cooling water passing through stems. (See analyses below.)

Cylinder Liner Wear Main Engine

Cylinder	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Maximum	.0115"	.008"	.0045"	.0125"	.0125"	.009"
Minimum	.01125"	.006"	.0015"	.000"	.00075"	.009"
Average	.0115"	.007"	.0025"	.0115"	.0125"	.009"

Bore Smaller at Some Points

Cylinder	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Maximum	.00525"	.00425"	.009"	.007"	.0025"	.00925"
Minimum	.0025"	.001"	.0025"	.0005"	.001"	.002"
Average	.004"	.002"	.0055"	.004"	.0015"	.0055"

Cylinder Liner Wear Compressor Unit (Power Cylinders)

Cylinder	No. 1	No. 2	No. 3	No. 4
Maximum	.005"	.00575"	.0025"	.0015"
Minimum	.0045"	.005"	.000"	.0015"
Average	.0045"	.0055"	.001"	.0015"

Main engine average liner wear represents the mean of six measurements. Two radial measurements were taken at three equally divided points of piston ring travel. Compressor unit average liner wear represents the mean of six measurements. Two radial measurements were taken at three equally divided points of piston ring travel.

Stops During Test

No. of Stops	Duration	Day of Test	Reason	Comp. Unit.	Main Engine Without Load
1	32 minutes	13th day	Two exhaust valves re'w'd	X	..
	44 minutes	13th day	Work on comp. unit	..	X
2	1 hr. 44 min.	26th day	Two 3rd stage comp. valves	X	..
	1 hr. 57 min.	26th day	Work on comp. unit	..	X
3	3 hrs. 6 min.	29th day	Compressor piston rings	X	..
	3 hrs. 7 min.	29th day	Work on comp. unit	..	X

Total time main engine without load, five hours and forty-eight minutes. Total time compressor unit stopped five hours and twenty-two minutes. First stop was to renew two leaky exhaust valves on compressor engine. Second stop was to replace two third stage compressor discharge valves which had become plugged. Third stop was to renew the piston rings in third stage of air compressors. Time main engine operated without load was made up at end giving thirty days running time. Cast iron exhaust valve disks were used on compressor engine at start, but were changed to nichrome during first stop period. The excessive wear on compressor parts is attributed to dirty air from shop in which tests were run.

CHEMICAL ANALYSIS OF DEPOSITS TAKEN FROM VARIOUS PLACES ON MAIN ENGINE AND AIR COMPRESSOR

Sample Number Taken from	Moisture	Oily Matter Soluble in Ether	Carbonaceous Matter Combustible Solid	Iron Oxides (FeO Fe_2O_3)	Copper Oxide (CuO)	Zinc Oxide (ZnO)	Manganese Oxide (MnO)	Silica (SiO_2)	Sodium Oxide (Na_2O)	Sulphuric Anhydride (SO_3)	Combined Water
No. 1 Compressor discharge valves H.p. stage	1%	0	17%	16%	29%	Trace	Trace	0	Trace	21%	16%
No. 2 Exhaust valve stem cage guide	1%	0	0	30%	3%	1%	Trace	2%	Trace	13%	48%
No. 3 Exhaust valve disk.	0	0	0	14%	Trace	0	0	0	Present in Considerable Amount	36%	0
No. 4 and No. 5 Piston crown	2%	20%	30%	20%	0	0	0	0	0	28%	0

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PART LOAD TESTS

FIRST MAIN ENGINE

Tests—Mar. 29-Mar. 30-1926	110% Load	105% Speed 110% Load	75% Load	50% Load	25% Load	No Load Astern
Duration	6 Hours	4 Hours	6 Hours	4 Hours	2 Hours	1 Hour
Pressure injection air	1,015 lbs.	1,000 lbs.	953.3 lbs.	878.8 lbs.	810.0 lbs.	975.0 lbs.
Pressure jacket cooling water	42.2	45.3	60	60	60	25
Pressure piston cooling water	42.2	45.3	60	60	60	25
Pressure lubricating oil	10	11	10.5	10	10	11
Temperature atmosphere	33.7° F.	30.5° F.	23.3° F.	31.0° F.	34.0° F.	32.0° F.
Temperature engine room	66.0° F.	66.0°	69.7° F.	60.0° F.	70.0° F.	72.0° F.
Temperature fuel oil	140.2° F.	143.3° F.	141.2° F.	148.3° F.	153.0° F.	130.0° F.
Temperature cooling water inlet	35° F.	35° F.	35° F.	35° F.	35.0° F.	35.0° F.
Temperature cooling water outlet	116.1° F.	115.4° F.	112.4° F.	111.0° F.	122.6° F.	82.6° F.
Temperature exhaust	796.6° F.	808.3° F.	572.5° F.	455.4° F.	312.5° F.	.....
High heat value of fuel	18,780 B.t.u.	18,780 B.t.u.	18,780 B.t.u.	18,780 B.t.u.	18,780 B.t.u.	.....
Low heat value of fuel *	17,706 B.t.u.	17,706 B.t.u.	17,706 B.t.u.	17,706 B.t.u.	17,706 B.t.u.	.....
Fuel oil, lbs. per hour	1,388.67	1,455.25	951.67	707.25	488.0	415.0
Fuel oil, lbs. per b.h.p. hour*	.431	.436	.427	.465	.593	.....
Fuel oil, lbs. per i.h.p. hour	.363	.364	.339	.367	.427	.541
Speed, r.p.m.	95.39	99.95	86.17	75.04	60.38	95.42
Indicated horsepower	3,664.40	3,831.40	2,686.1	1,844.2	1,093.0	734.75
Mean indicated pressure	105.38	104.83	83.69	68.83	49.18	21.00
Mean effective pressure	85.7	84.5	63.1	50.3	30.6	.....
I.h.p. of air compressors	.....	.....	.....	.....	.....	.....
Brake horsepower	2,980.94	3,087.26	2,025.00	1,346.97	679.27	None
Mechanical efficiency	81.35%	80.58%	75.39%	73.04%	62.15%	.....
Thermal efficiency	31.92%	31.55%	32.22%	29.58%	23.20%	.....

* Corrected to 18,500 B.t.u. and includes independent compressor unit plus B.h.p. carried on that unit.

COMPRESSOR UNIT

Tests—Mar. 29-Mar. 30-1926	110% Load	105% Speed 110% Load	75% Load	50% Load	25% Load	No Load Astern
Duration	6 Hours	4 Hours	6 Hours	4 Hours	2 Hours	1 Hour
Pressure injection air	1,081.7 lbs.	1,085 lbs.	1,025 lbs.	950 lbs.	875 lbs.	1,085 lbs.
Pressure jacket cooling water	29.8	28	27.5	28.7	28	24
Pressure piston cooling water	Pistons uncooled.					
Pressure lubricating oil	11.5	11.5	12	12	13	14
Temperature atmosphere	33.7° F.	30.5° F.	23.3° F.	31.0° F.	34.0° F.	32.0° F.
Temperature engine room	66.0° F.	66.0° F.	69.7° F.	60.0° F.	70.0° F.	72.0° F.
Temperature fuel oil	149.2° F.	150.8° F.	145.0° F.	158.5° F.	143.0° F.	146.0° F.
Temperature cooling water inlet	35.0° F.	35.0° F.	35.0° F.	35.0° F.	35.0° F.	35.0° F.
Temperature cooling water outlet	117.9° F.	120.0° F.	115.2° F.	118.7° F.	115.5° F.	113.5° F.
Temperature exhaust	670.8° F.	671.9° F.	625.1° F.	618.4° F.	649.2° F.	583.7° F.
High heat value of fuel	Included With Main Engine As One Fuel Tank Supplied Both Engines					
Low heat value of fuel *						
Fuel oil, lbs. per hour						
Fuel oil, lbs. per b.h.p. hour*						
Fuel oil, ibs. per i.h.p. hour						
Speed, r.p.m.	190	190	190	190	190	190
Indicated horsepower	555.2	563.6	524.7	487.6	447.1	.....
Mean indicated pressure	106.20	107.85	100.37	93.3	85.54	.....
Mean effective pressure	.....	.....	.....	.....	.....	.....
I.h.p. of air compressors	308.1	304.8	273.8	241.1	202.8	.....
Brake horsepower	108.06	108.06	108.06	108.06	108.06	108.06
Mechanical efficiency	.....	.....	.....	.....	.....	.....
Thermal efficiency	.....	.....	.....	.....	.....	

* Corrected to 18,500 B.t.u. and includes independent compressor unit plus B.h.p. carried on that unit.

WEAR OF THIRD STAGE COMPRESSOR LINERS

Compressor Number	Maximum	Minimum	Average
No. 1	.025"	.021"	.023"
No. 2	.025"	.017"	.020"
No 3	.032"	.018"	.025"

Four radial measurements were taken at unper point of piston ring travel and at center of cylinder. The average wear represents the mean of the eight measurements. All first and second stage liners were in excellent condition showing no wear. The three third stage liners were renewed after the test, due to dirty air from shop. All other parts of air compressors and engine were examined after the test and found in excellent condition.

SUMMARY OF SHOP TEST ON MCINTOSH AND SEYMOUR MARINE DIESEL ENGINES (SECOND ENGINE)

Date of tests: April 21-23, 1926.
Location, Auburn, N. Y.
Builder, McIntosh and Seymour Corporation.
Type of engine, 4 cycle, single acting. } Independent driven compressor unit.
Rated brake horsepower, 2,700 — 4 cycle trunk piston, single acting.
Number of working cylinders, 6. — 400.
Diameter of working cylinders, 32 inches. — 4.
Stroke of working cylinders, 60 inches. — 17 inches.
Diameter of compressor cylinders (3-3 stage). — 24 inches.
Stroke of compressor cylinders. — First stage 17¼ inches, 2nd stage 15 inches, 3rd stage 3½ inches.
12 inches.

Load	100%	115%	100% astern	100%	115%	100% astern
Duration	24 hours	5 hours	1 hour	24 hours	5 hours	1 hour
Pressure injection air	1,000.8 lbs.	1,010.0 lbs.	1,000 lbs.	1,037.2 lbs.	1,044 lbs.	1,025 lbs.
Pressure jacket cooling water	35.8 lbs.	30.2 lbs.	37.0 lbs.	26.6 lbs.	27.6 lbs.	26 lbs.
Pressure piston cooling water	35.8 lbs.	30.2 lbs.	37.0 lbs.	None	None	None
Pressure lubricating oil	10 lbs.	10 lbs.	10 lbs.	11.2 lbs.	11.5 lbs.	11.5 lbs.
Temperature atmosphere	57.1° F.	65° F.	60° F.	57.1° F.	65° F.	60° F.
Temperature engine room	71.4° F.	72° F.	70° F.	71.4° F.	72° F.	70° F.
Temperature fuel oil	133.2° F.	134° F.	134° F.	141.0° F.	140° F.	130° F.
Temperature cooling water inlet	38° F.	38° F.	38° F.	38.° F.	38° F.	38° F.
Temperature cooling water outlet	106.8° F.	113.9° F.	111.8° F.	117.3° F.	117.8° F.	120.5° F.
Temperature exhaust	760.8° F.	856.6° F.	791.6° F.	547.2° F.	552.5° F.	561.2° F.
High heat value of fuel	18,997 B.t.u.	18,997 B.t.u.	18,997 B.t.u.			
Low heat value of fuel*	17,900 B.t.u.	17,900 B.t.u.	17,900 B.t.u.			
Fuel oil, lbs. per hour	1,175.6	1,373.6	1,228	Compressor unit included.		
Fuel oil, lbs. per b.h.p. hour*	.402	.423	.415			
Fuel oil, lbs. per i.h.p. hour	.304	.316	.....			
Speed r.p.m.	95.51	99.40	97.0	191.15	191.0	190.1
Indicated horsepower	3,346.04	3,826.75	3,535.6	511.35	512.99	.....
Mean indicated pressure	95.64 lbs.	104.41 lbs.	99.67 lbs.	96.6 lbs.	97.42 lbs.	.....
Mean effective pressure	77.6 lbs.	84.2 lbs.	77.72 lbs.	.....	.....	.....
I.h.p. of air compressors	.....	.....	.....	270.6	275.63	.....
Brake horsepower	2,714.87	3,086.3	2,757.23	108.71	108.6	108.1
Mechanical efficiency	81.14%	80.65%	77.98%	.....	.....	.....
Thermal efficiency	34.22%	32.52%	33.15%	.....	.....	.....

* Includes compressor unit plus b.h.p. carried on that unit.

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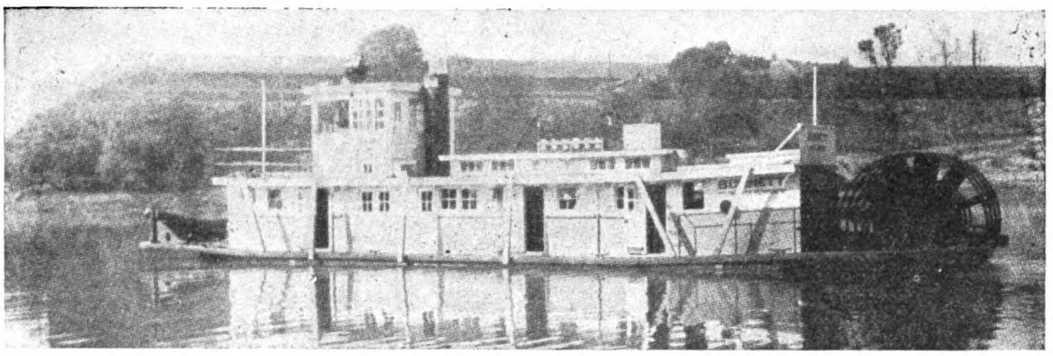

Fig. 1.—Diesel-electric towboat Burnett

Tests on Diesel-Electric Stern Wheel Towboats*

Results of performance tests recently conducted on two western river towboats designed and operated by the United States Engineer Department

By C. H. Giroux†

THE purpose of this paper is to make available the results of tests recently conducted on two stern wheel towboats designed and operated by the U. S. Engineer Department. While both boats are equipped with Diesel-electric propulsion machinery, they differ considerably in size, power and method of transmitting the energy to the wheel.

The *Burnett*, the smaller of the two, is driven by a 100 horsepower motor which is connected to the stern wheel through a double chain reduction. The first reduction of 4.67 to 1, between the motor and the jack shaft, is a silent chain completely housed and running in grease. The reduction between the jack shaft and the wheel shaft has a ratio of 4.23 to 1, and is accomplished by a roller chain driving on one end of the wheel only. The arrangement of the machinery on the *Burnett* is shown in Fig. 3. A general description of the hull and principal parts of the machinery is as follows:

PRINCIPAL DIMENSIONS OF HULL, TOWBOAT BURNETT

Builder	Nashville Bridge Company
Material of hull	Steel
Length, molded	70 feet
Length, overall	84 feet 2¼ inches
Breadth, molded	17 feet
Draft (test conditions):	
Forward	2 feet 9 inches
Aft	3 feet 1 inch
Overall diameter of wheel	11 feet 4 inches
Width of buckets	28 inches
Length of buckets	11 feet 2½ inches
Number of buckets	12 inches
Immersion of bucket tips	25 inches

MACHINERY OF TOWBOAT BURNETT

Main engine	1 Winton Diesel.
Main generator	1 General Electric, 85 kilowatts, 240 volts.
Exciter	1 General Electric, 7.5 kilowatts, 120 volts.
Propulsion motor	1 General Electric, 100 brake horsepower, 300/600 revolutions per minute.
Propulsion control	General Electric, variable voltage type, with motor field regulation; pilot house and engine room control.
Stern wheel drive	Link Belt, double reduction chain, total reduction 20 to 1.
Steering gear	Johnson-Fries, pneumatic.
Auxiliary generating set	Hill Diesel engine, General Electric 12-kilowatt, 115-volt generator.

The *Gouverneur* is equipped with a 225 horsepower motor which drives the jack shaft through the medium of a double reduction gear, which has a ratio of 24 to 1. This gear is totally enclosed and has a self-contained lubricating system. The bearings are of the roller type. The outboard bearings for the jack shaft are also of this type with the self-alining feature. The jack shaft is connected to the stern wheel by means of two composite wood and steel pitmans which are displaced from each other by an angle of 90 degrees. The arrangement of machinery on the *Gouverneur* is shown in Fig. 4. The principal dimensions of the hull and the main items of machinery are as follows:

PRINCIPAL DIMENSIONS OF HULL, TOWBOAT GOUVERNEUR

Builder	Howard Shipyards.
Material of hull	Steel.
Length, molded	100 feet.
Length, overall	121 feet ⅝ inch.
Breadth, molded	23 feet.
Draft (test conditions)	3 feet 6 inches.
Overall diameter of wheel	15 feet.
Width of buckets	23½ inches.
Length of buckets	15 feet.
Number of buckets	13
Immersion of bucket tips	31 inches.

MACHINERY OF TOWBOAT GOUVERNEUR

Main engines	2 Winton Diesel.
Main generators	2 General Electric, 90 kilowatts each, 115 volts.
Exciters	2 General Electric, 10 kilowatts each, 115 volts.
Propulsion motor	1 General Electric, 225 horsepower, 230 volts, 360/600 revolutions per minute.
Propulsion control	General Electric, variable voltage type with motor field regulation; pilot house and engine room control.

*Paper read at the thirty-fourth general meeting of the Sociey of Naval Architects and Marine Engineers, held in New York, November 11 and 12, 1926.

†Electrical Engineer, U. S. Engineer Department.

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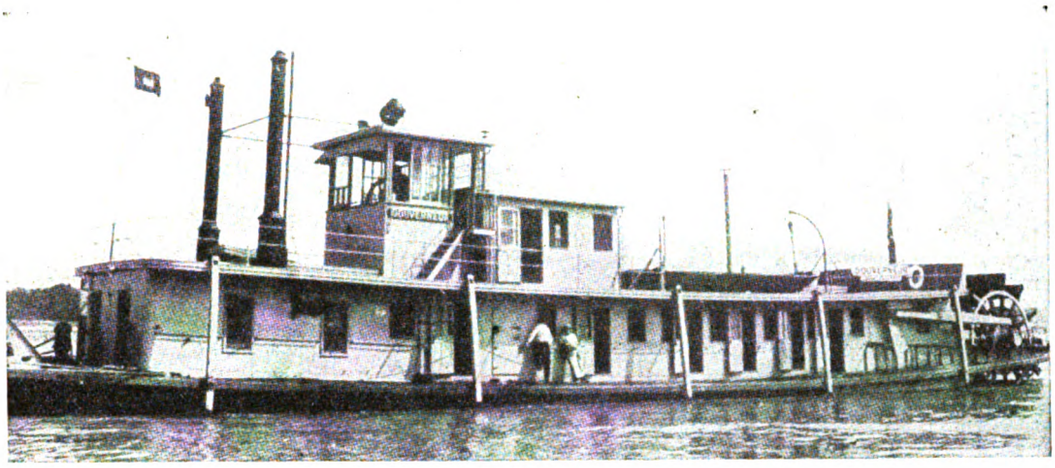

Fig. 2.—Diesel-electric towboat Gouverneur

Reduction gear	1 Niles-Bement-Pond.
Roller bearings.....	S. K. F. Industries.
Auxiliary generating set....	1 Hill Diesel Engine Company, 12 kilowatts, 115 volts.
Steering gear.....	1 American Engineering Company.

TEST ON TOWBOAT BURNETT

Speed Trials.—These trials were made to determine the speed of the vessel under varying conditions of power and variation in power for propulsion. It is therefore assumed that the results are the same as those which would be obtained in deeper water.

Weather.—The weather was clear and bright, with light variable winds, the effects of which were negligible, especially as the vessel was run over the course in both directions.

Equipment.—The original intention was to record all readings graphically, and equipment for this purpose was

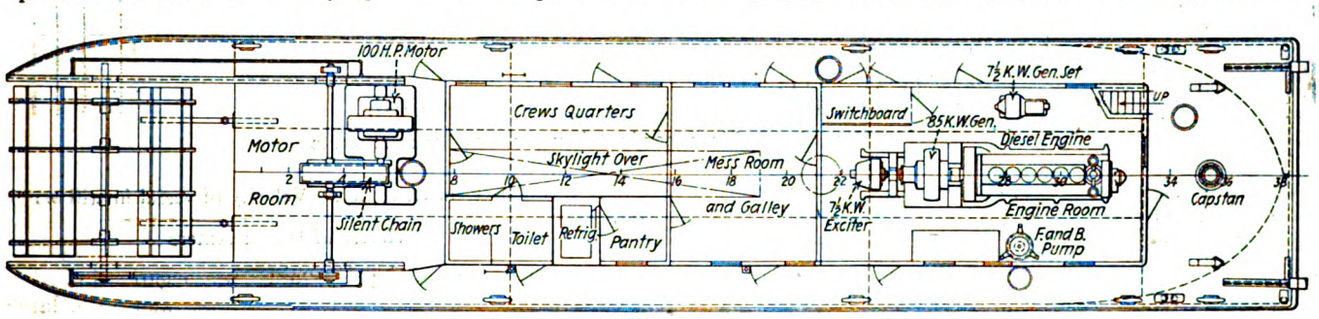

Fig. 3.—Main deck of the Burnett

wheel revolutions. Due to the fact that loaded barges of known tonnage and draft were not available, no data of practical value were secured as regards towing speed and power. One set of runs was made with a light barge having the following dimensions: length, 100 feet; breadth, 20 feet; depth, 5 feet; draft, 15 inches.

Course.—The course selected was on the Kentucky River just above Lock No. 4. It was 2,622 feet long and was marked by flags for time observations.

Current.—From the data taken the current is calculated to have averaged 0.2 mile per hour.

Depth.—The depth of water over the course varied from 12 to 20 feet, but in no place was it such as to produce any

installed in the pilot house. Upon trial, however, it was found that the graphic meters were seriously affected by the vibration and movement of the boat. Readings of power input to the propelling motor were therefore taken from indicating instruments. Readings of time, speed and wheel revolutions were recorded graphically by means of electrically operated pens. As all the charts of the recording meters were synchronized, simultaneous readings of the above were obtained (see Fig. 5).

The pen for recording time was operated by a chronometer which made a contact each second. Wheel revolutions were obtained by a contact maker on the wheel shaft. In order to obtain a record of instantaneous speed of the ves-

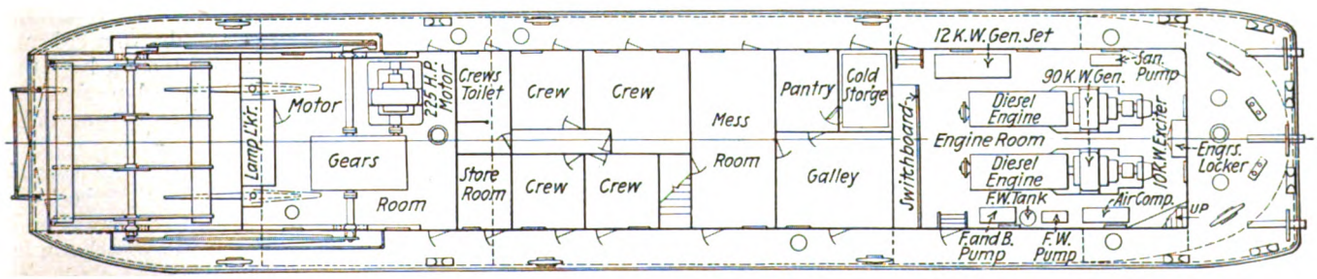

Fig. 4.—Main deck of the Gouverneur

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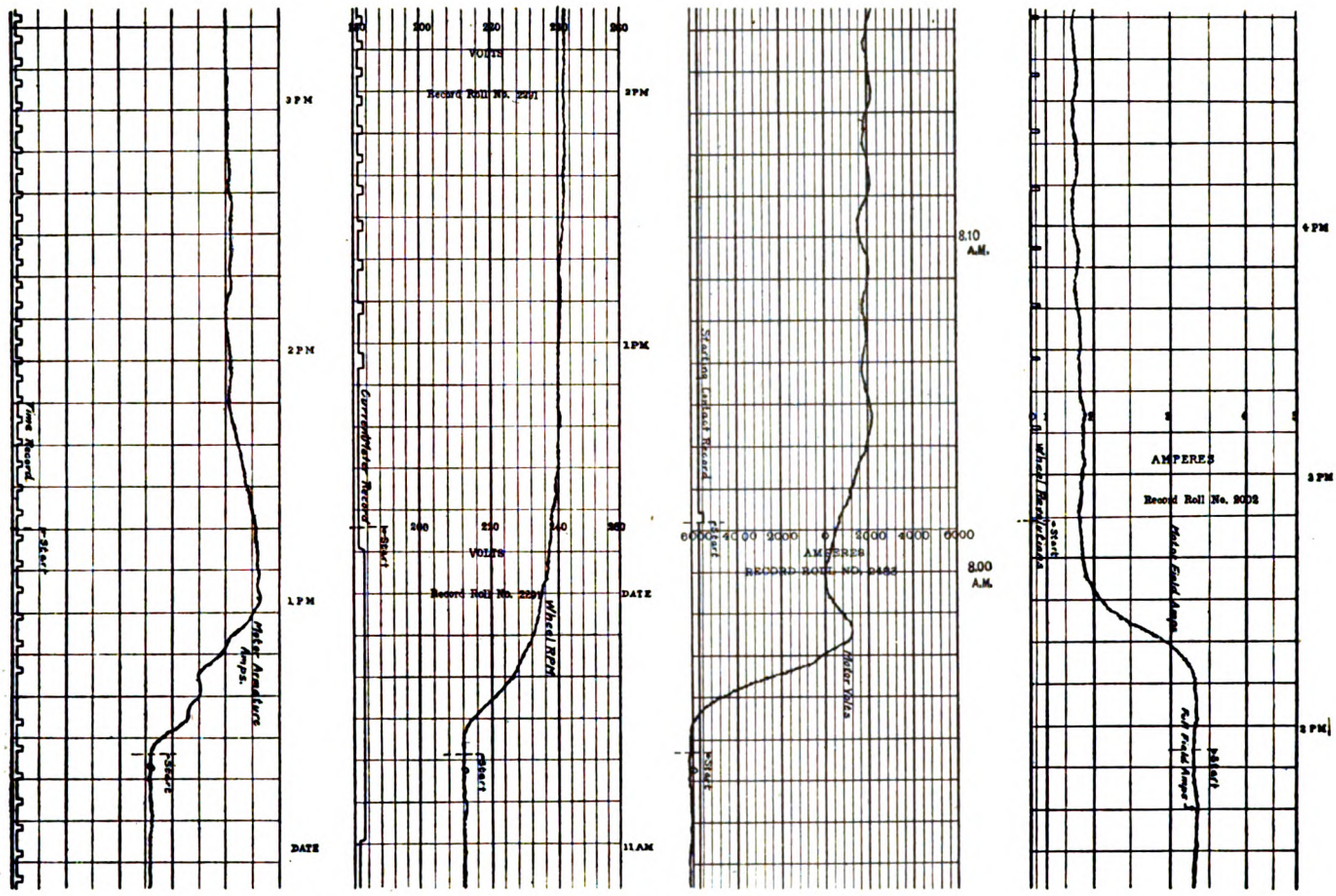

Fig. 5.—Samples of graphic records taken on performance tests

sel and to check the observed readings, a Gurley current meter was employed (see Fig. 6). This instrument consists essentially of a bucket wheel mounted in pivot bearings on a frame which is submerged. Vanes keep the wheel in a horizontal plane and also keep it in a straight path. A heavy weight prevents the wheel from coming to the surface. At each five revolutions of the wheel an electrical contact for operating the recording pen is made. The meter was towed over the side of the vessel at a sufficient distance away to eliminate the effect of the wake. As the current meter gives a true reading of speed of the vessel through the water, regardless of stream conditions, it is considered a very useful instrument in connection with speed trials where still water cannot be obtained.

A fourth pen, operated by a push button, was used to record the instant of passing the distance flags.

An additional check on the speed was taken by a stop-watch.

Results.—The results of the speed trials are shown graphically in Fig. 8, and need little explanation. The values of motor horsepower were obtained from readings of current and voltage taken on the trials and subtracting the motor losses as shown by factory tests. These values are therefore the motor output at the driving sprocket. The apparent slip was calculated by use of the formula:

$$\text{Slip} = \frac{\text{Velocity of bucket centers—Velocity of vessel in still water}}{\text{Velocity of bucket centers}}$$

The fact that most of the slip values are negative indicates that the wake factor was quite large on this vessel. Values of miles per hour are those which would be obtained in still water, calculated from the average of the speeds upstream and downstream and checked by readings of the current meter.

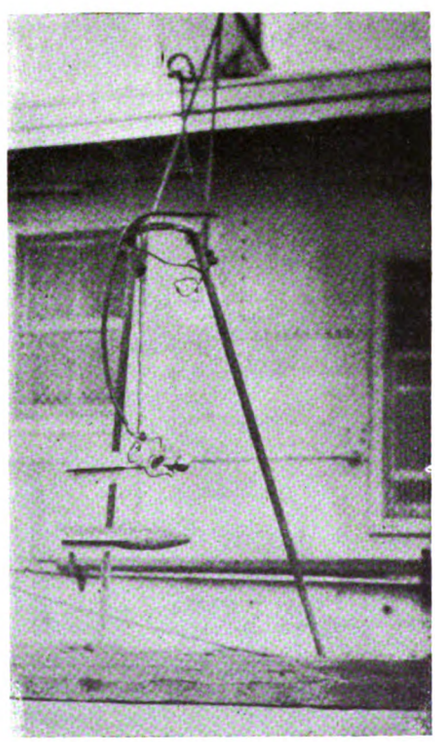

Fig. 6.—Gurley current meter

Dock Test.—The dock test was made to determine the efficiency of the transmission between the motor and the wheel shaft, the power required to drive the wheel at various speeds, and the wheel thrust under these conditions.

Equipment. — Measurement of power input to the motor was taken by indicating ammeters and voltmeters. Wheel revolutions were taken by an observer with a stop watch. To measure the wheel thrust a dynamometer was mounted at the forward end of the vessel so that the push against a fixed barge was indicated on a pressure gage.

Readings were taken with several depths of immersion of the wheel obtained by ballasting the forward end.

Results.—The results are shown by curves in Fig. 9.

Values of motor horsepower were calculated from the readings of

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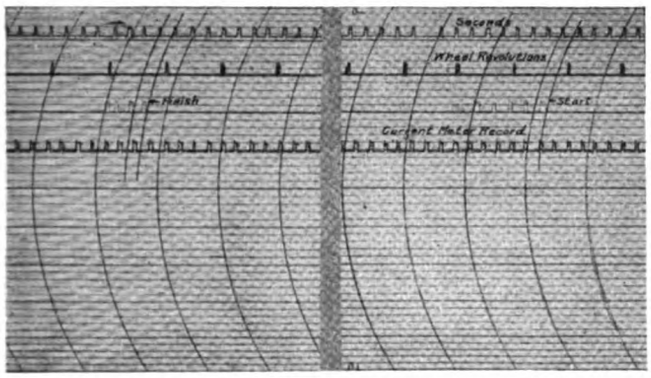

Fig. 7.—Sample chart of operation recorder on tests on the Gouverneur

motor input minus the losses shown by factory tests. These values are, therefore, the motor output measured at the driving sprocket.

The wheel horsepower is the power delivered to the wheel shaft and was calculated by the formula:

$$\text{H. P.} = \frac{\text{Lb. thrust} \times 2 \times 3.1416 \times \text{Foot radius} \times \text{R. P. M.}}{33{,}000}$$

All variables in this formula except the radius were determined directly from the readings taken on the test. The radius for determining the wheel horsepower is the distance from the center of the wheel shaft to the center of pressure of the buckets. This was determined graphically on the assumption that the waterline is not affected by the movement of the buckets. It is appreciated that this method is not extremely accurate, but it is believed that the percentage of error is small and probably is no greater than any other practicable method of measuring the wheel horsepower.

The efficiency of the transmission between the motor and the wheel is found by dividing the wheel horsepower by the motor horsepower at any given revolutions. Efficiencies were calculated for several different immersions of the wheel, as it was thought that it would be influenced by the speed as well as the horsepower, but it was found to be practically constant within the limits of the test. Therefore, the results obtained with normal immersion only are shown.

The wheel thrust was taken directly from the dynamometer readings and represents the effort available at zero speed of the vessel.

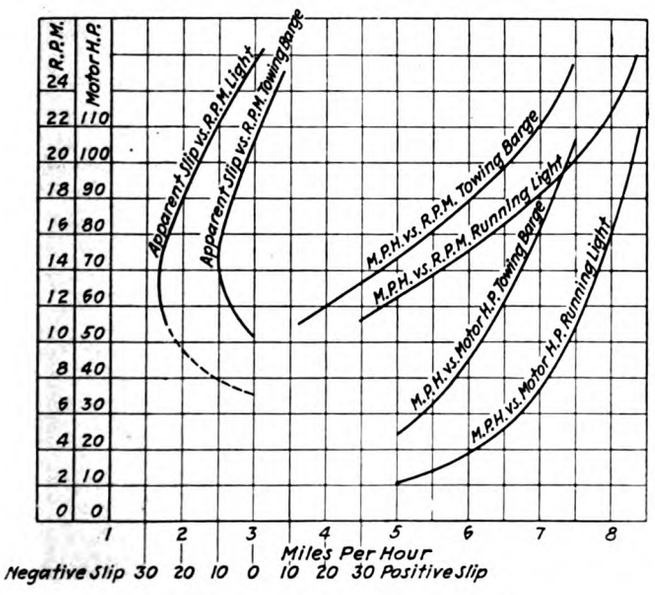

Fig. 8.—Speed tests on the Burnett

Acceleration and Deceleration Test.—These tests were made to ascertain the time required for maneuvering. Full load current was applied as quickly as possible from the instant of starting and was maintained nearly constant throughout the tests. Graphic meter records were taken, but no effort has been made to analyze the electrical readings on account of the inaccuracy of the graphic meters. The time, current meter and wheel revolution records were used to obtain the data tabulated below:

	Seconds
Time to accelerate from 0 M.P.H. to 8.15 M.P.H.....	30
Time to decelerate from 8.15 M.P.H. ahead to 0 M. P. H...	25
Time to accelerate from 0 M.P.H. to 5.2 M.P.H. astern...	25
Time to decelerate from 5.2 M.P.H. astern to 0 M.P.H.....	21

TESTS ON TOWBOAT GOUVERNEUR

Speed Trials.—Trials were run on the *Gouverneur* to determine the speed under various conditions of power and

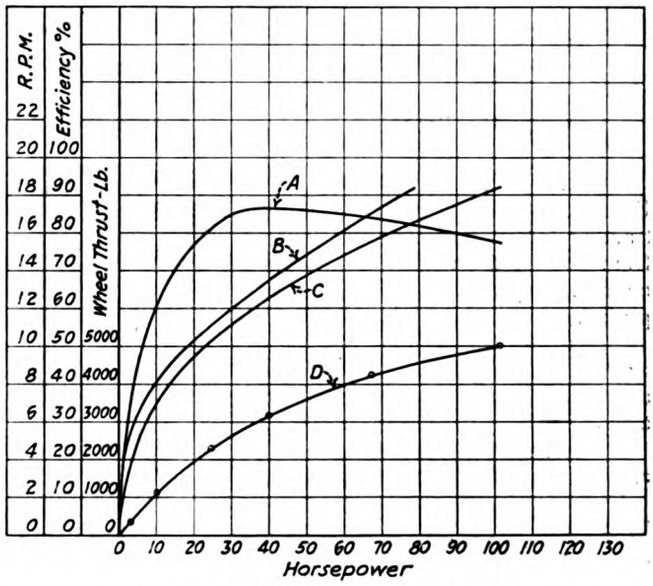

Fig. 9.—Dock test on the Burnett

A—Transmission efficiency vs. motor horsepower. B—Wheel horsepower vs. revolutions per minute = C × A. C—Motor horsepower vs. revolutions per minute. D—Wheel thrust vs. motor horsepower.

wheel revolutions. Loaded barges were not available, and therefore tests without tow only were made.

Course.—The trials were run over a half-mile course in the Mississippi River opposite the city of St. Louis.

Depth of Water.—Soundings were taken at several points on the course, and the average depth was found to be 37 feet with a minimum depth of 35 feet.

Current.—The boat was anchored at a number of places on the course and the current measured with the Gurley current meter. It was found to average 3.78 miles per hour.

Weather.—The weather was fair with intermittent breeze downstream. As the course was run in both directions for each condition, the effect of the wind is considered to be negligible.

Equipment.—Due to difficulties which were encountered with graphic recording meters on the *Burnett*, they were not installed on the *Gouverneur*. All electrical readings were taken with indicating meters and recorded at frequent intervals by an observer. Wheel revolutions, current meter readings and time were recorded by means of an Esterline operation recorder. The instant of passing each distance marker was recorded on the same chart. A sample chart is shown in Fig. 7.

The Gurley current meter was used in the same manner as on the *Burnett*.

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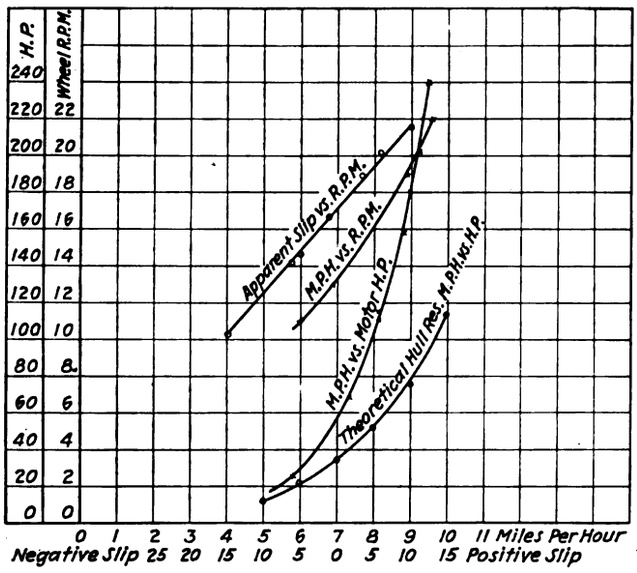

Fig. 10.—Speed tests on the Gouverneur

Results.—The results of the speed trials are shown in Fig. 10. Values of motor horsepower were found by subtracting the motor losses, as determined by factory tests, from the readings of input taken during the tests. The motor horsepower is therefore that delivered to the motor pinion.

The miles per hour shown on the curves are those which would be obtained in still water, and were found by averaging the speed upstream and downstream. Speeds were also checked by the current meter records.

The apparent slip was calculated by the same formula as given under tests on the *Burnett*.

The curve of theoretical hull resistance was not obtained by test but was calculated from model tests on other vessels having similar lines.

Dock Test.—The dock test on the *Gouverneur* was conducted along the same lines as that on the *Burnett*. Readings of motor input were taken with indicating meters and were recorded frequently by an observer. The wheel revolutions and seconds were recorded by the operation recorder. Wheel thrust was measured by a dynamometer mounted on the forward end of the vessel and arranged so that the thrust against a fixed object was indicated on a pressure gauge.

Tests were made with various depths of immersion of the wheel and also with the outer row of buckets removed. Ballast was placed on the forward deck to raise the wheel in the water for these tests.

Results.—Upon starting the tests it was found that there was a decided fluctuation of power, twice during each revolution of the wheel. This fluctuation caused the boat to surge against the dynamometer and thus seriously interfered with the accuracy of the thrust readings. The high and low values of thrust and power input to the motor were recorded and plotted. The results, shown in Fig. 11, are the weighted averages and should therefore be considered as only approximate.

The wheel horsepower is the power delivered to the wheel shaft and was calculated as explained under the tests on the *Burnett*.

The curve of transmission efficiency was derived by dividing the wheel horsepower by the motor horsepower.

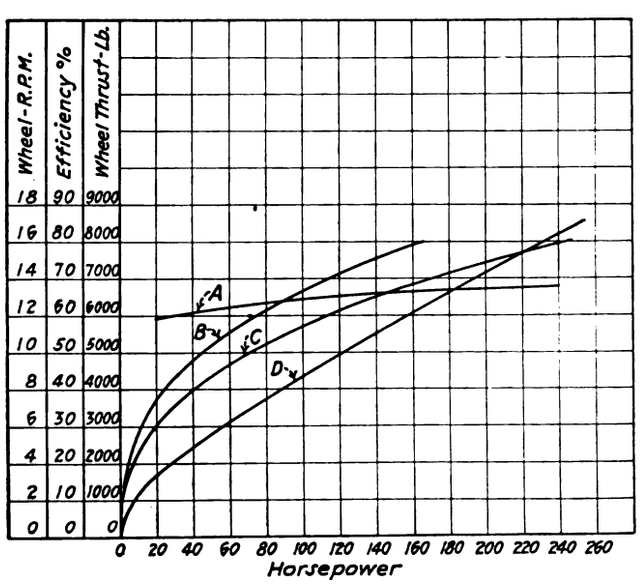

Fig. 11.—Dock test on the Gouverneur

A—Transmission efficiency vs. motor horsepower. B—Wheel horsepower vs. revolutions per minute = C × A. C—Motor horsepower vs. revolutions per minute. D—Wheel thrust vs. motor horsepower.

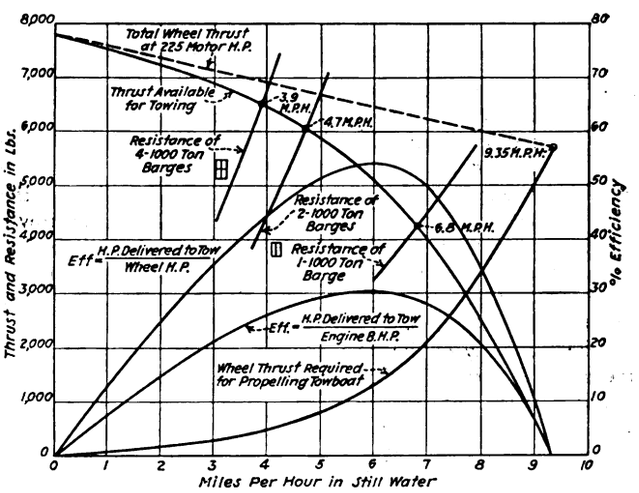
Total Wheel Thrust at 225 Motor H.P.
Thrust Available for Towing
3.9 M.P.H.
4.7 M.P.H.
9.35 M.P.H.
Resistance of 4-1000 Ton Barges
Resistance of 2-1000 Ton Barges
6.6 M.P.H.
Resistance of 1-1000 Ton Barge
Eff = H.P. Delivered to Tow / Wheel H.P.
Eff. = H.P. Delivered to Tow / Engine B.H.P.
Wheel Thrust Required for Propelling Towboat
Thrust and Resistance in Lbs.
% Efficiency
Miles Per Hour in Still Water

Fig. 12.—Calculated towing characteristics of the Gouverneur

This efficiency therefore includes all losses between the motor shaft and the buckets on the wheel. As the efficiencies were not greatly affected by the speed at a given horsepower, only those which apply to normal immersion of the wheel are given.

Conclusion

The tests described in this paper are but a beginning of the work which the author hopes to do along this line as soon as time and equipment are available. It is appreciated that much desirable data are missing due to the practical limitations under which the tests were conducted.

Appendix

The tests originally scheduled for June were not started until about the middle of July, and for this reason there was only time for such tests as could be completed quickly with the equipment at hand. Furthermore, it was felt that from the data secured from running light and dock tests, the performance of the vessels under towing conditions could be calculated with a fair degree of accuracy.

After the paper was written, performance curves were calculated and are presented in Figs. 12 and 13.

Fig. 12 shows the calculated towing characteristics of the *Gouverneur*.

The basis for all the other characteristics is the dotted line marked "Total wheel thrust at 225 Motor H.P." The

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thrust at zero M.P.H. was obtained directly from the dynamometer reading on the dock test. The thrust at 9.35 M.P.H. (the running light speed) was determined from the running light tests. It was assumed that the thrust at intermediate speeds varies as a straight line, an assumption

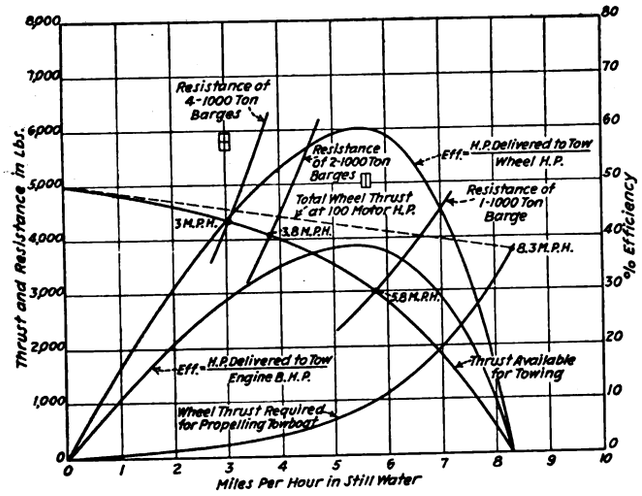
Thrust and Resistance in Lbs.
% Efficiency
Miles Per Hour in Still Water
Resistance of 4-1000 Ton Barges
Resistance of 2-1000 Ton Barges
Total Wheel Thrust @ 100 Motor H.P.
Resistance of 1-1000 Ton Barge
Eff. = H.P. Delivered to Tow / Wheel H.P.
Eff. = H.P. Delivered to Tow / Engine B.H.P.
Thrust Available for Towing
Wheel Thrust Required for Propelling Towboat
3 M.P.H.
3.8 M.P.H.
5.8 M.P.H.
8.3 M.P.H.

Fig. 13.—Calculated towing characteristics of the Burnett

that has been proven, from tests on other vessels, to be correct within practical limitations of measurement.

The curve marked "Wheel thrust required for propelling towboat" was calculated directly from the running light tests as given in the original paper.

Subtracting the values of thrust as shown by the latter curve from the total thrust, produces the curve marked "Thrust available for towing." This is the curve in which

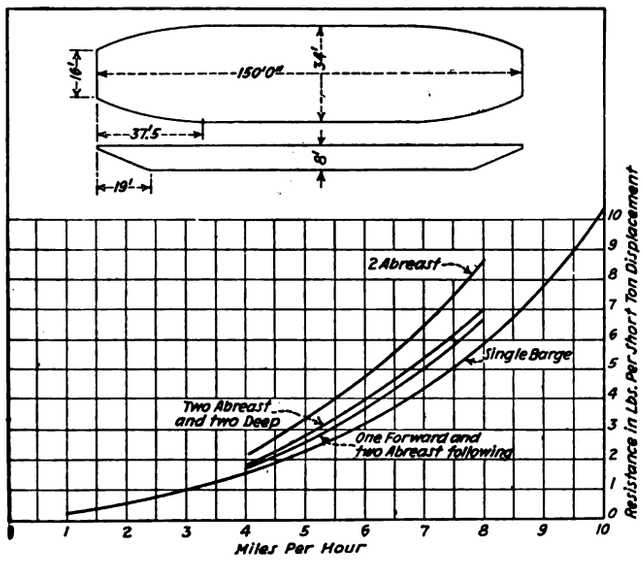

Fig. 14.—Deep water resistance of model barges at load displacement of 932 short tons

we are most interested, because from it we may determine the performance of the vessel under any condition of towing service.

As an illustration, three curves have been drawn showing the resistance of barge combinations as determined from model basin tests. The points where these resistance curves intersect the curve of available thrust, determine the speeds at which the tows can be handled in still water. The barges used for this illustration are models essentially the same as those used by the U. S. Engineer Department at St. Louis, and have a length of 150 feet, beam of 34 feet and depth of 8 feet.

The higher of the two efficiency curves shown, was obtained by dividing the horsepower delivered to the tow (obtained by multiplying the available thrust by the speed) by the horsepower at the wheel shaft. This curve, then, is a measure of the wheel loss and towboat resistance loss.

The lower of the two efficiency curves includes all electrical losses and mechanical losses in the transmission as well as those mentioned above.

Attention is called to the shape of the efficiency curves. The maximum efficiency occurs at about 6 miles per hour, which means that at that speed, with a towing effort of slightly greater than 5,000 pounds delivered, the towboat considered as a piece of machinery is working at the most advantageous point. It does not necessarily follow that this is the most economical towing condition considering the amount and value of the cargo transported, but it does show the value of a thorough analysis of operating conditions so that the best design of hull and machinery can be selected.

Fig. 13 shows the calculated towing characteristics of the *Burnett*. The higher overall efficiency of this boat over the *Gouverneur* is almost entirely due to the lower transmission loss between the motor and the wheel shaft, as indicated by the results of the dock tests of the two vessels, included in the original paper.

Shipping Board Recommends That Government Transport System Be Abolished

A RECOMMENDATION that the present system of Army, Navy, and Panama transports be abolished is included in a report submitted to Chairman T. V. O'Connor of the Shipping Board by the board's Bureau of Operations. The report declares that the business now being handled by these services would be of great value in building up our private merchant marine, indicating that under present conditions there is a living example of the government competing directly with private enterprise. In the three transport services now maintained by the government there are some 30 vessels of approximately 7,500 deadweight tons each. The cost of operating these vessels is about $10,000,000 per year, and, according to the report, should this fund be expended for the services of private American shipping it would constitute a government aid of the type which has received the support of the board.

J. Caldwell Jenkins, director of the bureau of operations, in transmitting the report to the chairman, stated that carriage of passengers and freight by these transports should be abolished. "It must be evident to the most casual student of the subject," he said, "that for the Army and Navy, in competition with private American shipping, to maintain its own steamship lines across the ocean in time of peace, where ample private steamship service is available, is unsound and detrimental to private initiative just as would be the case if they maintained their own railway lines across the continent."

The report compares the American practice of carrying troops and supplies to overseas possessions with that of current practices of foreign nations. It finds that no other nation in the world deprives its private commercial interests of this traffic.

Some steps have been taken to put the navy transport business in private ships. The navy has settled a policy of putting its own transports out of commission as fast as reliable commercial service can be obtained. "It does this for two reasons," Mr. Jenkins states. "First, because it

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knows that by patronizing the country's fast, modern merchant ships it will get the benefit of better service at no greater cost than at present; secondly, because it will be aiding the growth of the merchant marine."

The report proposes a Marine Transport Bureau, an impartial body functioning under the Shipping Board, which would include in its personnel duly accredited representatives of the Army, Navy, Marine Corps and Panama Canal. These representatives would act as liaison officers between the organizations mentioned and the Shipping Board. They would submit the transport requirements of their respective departments, and advise as to the special equipment needed on vessels thus used, conduct joint inspection of vessels in company with officials of the Shipping Board, assist in drawing up necessary regulations, certify passenger and cargo rates, and perform other advisory duties not connected with the actual operation of ships. Final responsibility for adequacy of service, however, would rest wholly with the Shipping Board.

JONES INTRODUCES BILL IN SENATE

Senator Jones of Washington has introduced a bill in the Senate directing the discontinuance of the Army and Navy transport services whenever the President shall determine that adequate transportation facilities to meet all the needs of the Army, Navy or Marine Corps are afforded by vessels registered or enrolled and licensed under the laws of the United States. The President would be authorized to transfer the transport service vessels to the Shipping Board and the War and Navy departments would be authorized to make contracts for terms of not exceeding ten years for such transportation as they required.

THE PRESIDENT'S ATTITUDE

President Coolidge, it was said in his behalf at the White House on January 14, will take no action on the proposal to abolish the Army, Navy and Panama transport services until he has consulted with the Departments of War and Navy.

President Coolidge believes, however, it was explained at the White House, that the Army and the Navy may be solicitous about giving up control of their own transports and, in view of this, he is inclined to doubt whether anything can come of Chairman O'Connor's proposal.

Dwight F. Davis, Secretary of War, stated orally January 14 that the War Department did not favor the transfer because of the fact that it was difficult to convert merchant vessels into army transports in times of emergency. Secretary Davis also recalled the fact that the Shipping Board owes the Army one transport or failing its return it owes the War Department $3,000,000, as a result of World War operations.

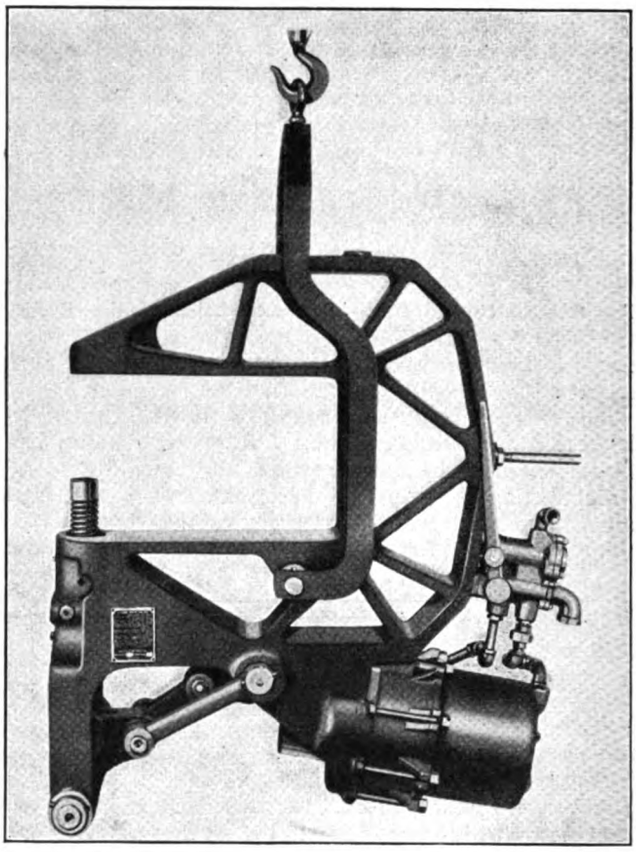
Hanna Portable Compression Yoke Riveter

ONE of the features of the new Hanna portable compression yoke riveter shown in the accompanying illustration is the alloy steel truss frame construction which ensures the desired rigidity and strength with the use of a minimum of metal. This riveter has a reach of 24 inches, a gap of 15 inches, is capable of exerting a pressure of 50 tons on the rivet die at 100 pounds air pressure and weighs only 1,500 pounds.

Suspended as shown, rivets are inserted from above and headed from below making possible pinch bug (nutcracker) riveting speeds. Rivets may be placed far in advance of the riveter, enabling the "rivet-sticker" to give a portion of his time to drift pins and stitching bolts without interrupting continuous riveting. The machine may also be suspended dies vertical, cylinder up or dies horizontal, cylinder up.

Another feature is the method of mounting the air actuating cylinder making possible a distance of only 29 inches from the inside top surface of the live stake to the bottom of the rear cylinder head. This permits the riveter being used where work is laid down for riveting, the height of which is determined by what is desirable when reaming.

The control of the intake and exhaust air is through a Hanna combination operating valve which is a distinct unit mounted at any convenient location and may be operated by hand or foot. Two air hoses with an inner area equal to that of a one inch pipe lead from valve to cylinder. The



Portable compression yoke riveter in the suspended position

valve combines two distinct types of valves—the balanced poppet and the balanced piston—making an air tight and free-moving valve. The most important feature of this valve is that any slight leakage at the valve will be from machine to exhaust, not from line to machine, or line to exhaust. The operating valve is designed especially to meet this service.

The pressure exerting mechanism is a combination of simple lever and toggle which combine a long die stroke with a wide range of uniform pressure. The first part of the die stroke is very rapid as the upper die approaches the work. The die or plunger speed gradually decreases until it enters the uniform pressure area of the stroke. The advantage claimed for this die stroke is, where the work is lightest the speed is greatest; as the rivet head forms, the pressure increases, reaches a maximum and maintains it for several inches of piston travel. Ordinary variations in rivet lengths and plate thicknesses are automatically taken care of by the wide range of uniform pressure.

This machine and riveters of other types are made by the Hanna Engineering Works, Chicago, Ill.

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Merchant Marine Policy Still Undetermined

Shipping Board appropriation bill passed—Construction loan fund amendment receives favorable consideration

By Harold F. Lane

WASHINGTON, D. C.

ANOTHER session of Congress is approaching its adjournment on March 4 without having come any nearer to the adoption of a definite merchant marine policy than have its predecessors for several years. Congress has passed the appropriation bill providing funds for the Shipping Board and the Fleet Corporation for another year and the President has signed the bill. The Senate also has passed, and the House committee on merchant marine and fisheries has submitted a favorable report on the bill to amend the provision in the 1920 act relating to the construction loan fund, authorizing the board to set aside for the fund revenues derived from sales and operations until the fund is built up to $125,000,000. The Shipping Board has submitted to the Senate alternative plans for the maintenance of a merchant marine either through private ownership and operation or by government ownership and operation and Senator Jones has introduced bills in the Senate along the lines recommended, but any serious consideration of the subject has been postponed until another session.

BILLS DRAFTED BY THE SHIPPING BOARD

The two bills were introduced in the Senate on February 10 in connection with a speech by Senator Jones in which he said that action was not expected at this session but that the bills were offered so that they might be studied before the next session of Congress. Both were drafted by the Shipping Board and were sent to the Senator following the report made by the board on January 11 of its recommendations in response to Senate Resolution 262. S. 5669 embodies a ship subsidy schedule which the board feels would be appropriate if Congress decides to adopt a ship subsidy measure to promote the operation and ownership of merchant ships by private capital. S. 5668 represents the ideas of the board as to what is essential now to further establish economical and efficient operation by the government and at the same time hold the door open for the further development of private operation if Congress decides to amend the merchant marine act to provide for a more definite and adequate policy concerning this form of promoting a merchant marine.

Senator Jones in his speech said that every Senator ought to "make himself a propagandist during the summer" with a view to the adoption of a definite policy at the next session, because the ships now owned are fast wearing out and if a replacement program is to be adopted, time will be required both to get legislation through Congress and also for the planning and building. After asserting that the United States is rapidly falling behind for lack of a definite marine policy he said that he was convinced that without the aid of some kind of subsidy we will not get a merchant marine in the foreign trade through private capital and that he had reached the point where he was willing to vote for government ownership and operation because he did not think we can get it by any other method at present available.

Senator Jones also said that if Congress does adopt a definite policy he had no doubt that the $125,000,000 loan fund could be used as a revolving fund to provide for the building of ships under whatever policy is adopted and that meanwhile it will be available for loans to those who will undertake the construction of ships for operation under the American flag.

THE LOAN CONSTRUCTION FUND AMENDMENT

Commissioner Benson of the Shipping Board, who is in charge of its bureau of construction, has prepared the following analysis of Senate Bill 3896, which was reported to the House on February 10 after having been passed by the Senate:

"This bill has in view giving full effect to the policy laid down by Congress in Sec. 11 of the Merchant Marine Act, 1920, authorizing a Construction Loan Fund from which loans can be made by the Shipping Board to private citizens, in aid of the construction of new vessels by them, as distinguished from any construction program the government might itself elect to undertake; no part of the fund is usable by the board.

"Under the terms of the original Act the board was authorized to set aside $25,000,000 per year for five years, hence the fund intended by Congress to be created was to amount to $125,000,000. The five-year period expired June 5, 1925, but the total amount set aside to that date and which was allowed to remain as a part of the fund by the Treasury Department, amounted to $67,740,499.58. There had also been set aside $11,808,729.48 as revenues from sales, but the Treasury held that it could not remain a part of the fund because the amount which could be set aside in any one year was $25,000,000 under the terms of the original Act, and the amount named was in addition to and in excess of the $25,000,000.

"Just previous to the expiration of the five-year period, the board set aside securities having an aggregate face value of $18,464,177, which had been taken by it for deferred payments on sales, which payments were to accrue subsequent to the expiration of the time limit. The board could have sold these securities before the expiration of the time and no question would have arisen as to the proceeds being properly credited to the fund, but the Treasury ruled that cash only could be transferred to the fund, and therefore the securities could not be allotted to it. The Comptroller General, however, very kindly made provision for a suspense account to which all payments from these securities were credited, pending the action of Congress on the present bill, which among other things, validates credits to the fund of proceeds from securities taken in connection with sales of property.

"The amount of the fund now available for future loans is $38,305,135.64, which amount is the balance of the total fund after deducting the loans heretofore actually made, aggregating $9,158,000; less also loans that have been promised though the funds have in fact not been advanced, aggregating $6,400,000 (thus making the total amount of loans, either made or promised, in aid of the construction of privately owned vessels, $15,558,000); less also approximately $14,600,000, which is authorized by the Act of June 6, 1924, to be used by the board in advancing the Diesel construction program now in progress. The cash at present (February 10, 1927) in the fund is $59,305,135.64, which includes $627,865.34 which has been repaid on account of loans heretofore made. The commitments just referred to (aggregating $21,000,000) deducted from the cash on hand ($59,305,135.64) leaves, as stated above, $38,305,135.64 as available for future loans.

"The most important change in the present law is the fact that the limitation in point of time has been removed, and the board may continue crediting to the construction loan fund proceeds of sales until the full amount of $125,000,000 has been attained. There are other incidental provisions such as that just mentioned that proceeds of securities taken in connection with sales shall also accrue to the fund; and the interpretation already given that the fund is a permanent revolving fund is confirmed.

"As previously stated, the board has no authority to expend any part of the fund in the construction of new vessels for the government; it not only is not an appropriation for expenditures, but the fund in fact is a source of definite revenue to the government, inasmuch as the interest collected substantially exceeds the

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interest rate paid by the government on its outstanding funded debt. The greatest care is taken to assure the repayment of the principal of the fund; thus far not one cent has been lost. The minimum rate of interest which the board is permitted to charge is 5¼ percent per annum, unless the vessel on which the loan is made is operated in foreign trade; when thus operated, the concession of 1 percent is made in the interest rate, the minimum in those cases being 4¼ percent per annum. The concession in the interest rate in favor of foreign trade has in view, of course, reducing the operating costs of American vessels when in competition with foreign flag vessels in foreign trade.

"The fact that the aggregate of the loans which have been made during the past twelve months amounts almost to as much as the total loans made during the preceding five years, reflects the importance of having ample funds in hand to meet requirements when a substantial revival of shipping comes and private capital is seeking aid from this source in the promotion of shipping enterprises."

JONES BILL PROVIDES FOR REPLACEMENT PROGRAM

Senator Jones on February 22 introduced a new bill, S. 5792, providing as follows:

"That the policy declared in section 1 of the Merchant Marine Act, 1920, is hereby confirmed, and the purpose of the United States to maintain permanently a merchant marine adequate for the proper growth of the foreign and domestic commerce of the United States and for the national defense is hereby reaffirmed.

"Sec. 2. The board shall not sell any vessel or any line of vessels when in its judgment the building up and maintenance of an adequate merchant marine can be best served by continued ownership of such vessel or such line by the United States.

"Sec. 3. In addition to ordinary repairs to vessels incident to their regular operation, the board may recondition and improve vessels owned by the United States and in its possession or under its control, so as to equip them adequately for competition in the foreign trade of the United States.

"Sec .4. The necessity for the replacement of vessels owned by the United States and in the possession or under the control of the board and the construction of additional up-to-date cargo, combination cargo and passenger, and passenger ships, to give the United States an adequate merchant marine, is hereby recognized, and the board is authorized and directed to present to Congress from time to time, recommendations setting forth what new vessels are required, and the estimated cost thereof, to the end that Congress may, from time to time, make provision for replacements and additions. All vessels built by the board shall be built in the United States, and they shall be planned with reference to their possible usefulness as auxiliaries to the naval and military services of the United States.

"Sec. 5. No vessel constructed pursuant to this Act shall be sold without the consent of Congress hereafter given.

"Sec. 6. The appropriations necessary to carry out the provisions and accomplish the purposes of this Act are hereby authorized.

"Sec. 7. All Acts and parts of Acts inconsistent with this Act are hereby repealed."

The Senate and the House as this is written continue to disagree as to whether the Navy shall proceed with the construction of the three light cruisers already authorized. The Senate, in passing the naval appropriation bill, included an amendment providing $1,200,000 for this purpose, which had not been provided for either in the Budget estimate or in the bill as it passed the House. On February 22, Senator Hale announced in the Senate that the House conferees on the bill had refused to assent to this provision and the Senate instructed its conferees to continue to insist on the amendment.

New Line of Steel Switchboards

A SIMPLE construction of steel switchboard panel, with several outstanding advantages, can now be furnished by the General Electric Company, Schenectady, N. Y. The construction is such that the new board partakes of the conventional switchboard features to an extent that makes it possible even to install the new and old types together, temporarily or permanently. Combinations of steel and slate or ebony asbestos panels on one board will be practicable with the use of the new design.

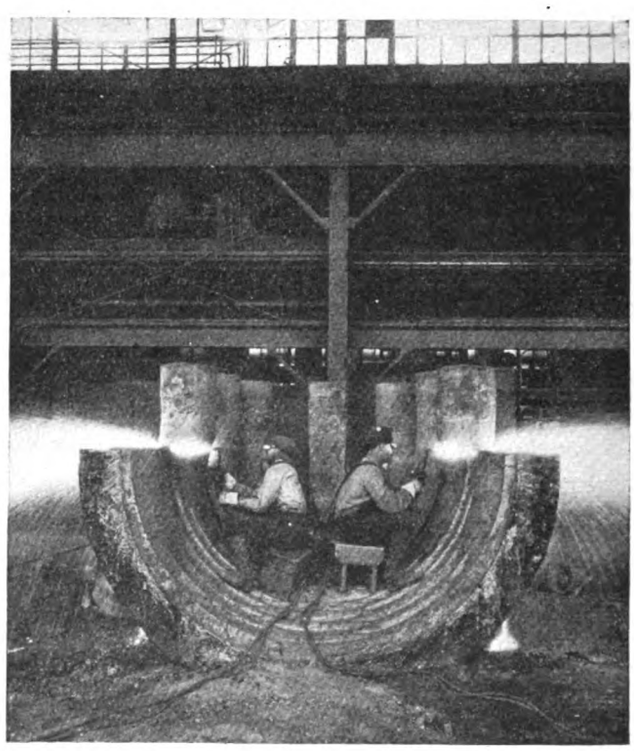
General Electric pipe supports are retained on the steel panels. Each panel can be shipped completely wired without unusual care and bracing in packing. In erecting the board, the framework is set up first, and the individual panels are then installed one by one. The panel wiring is grouped in trough-shaped recesses at the sides of each panel.

When installing slate or ebony asbestos panels adjacent to the new steel design, the so-called angle-pipe construction of support is used; i.e., the former are mounted on light angles placed ⅛ inch inside the edges of the panels. These angles serve to support the several sections of the panels, and the wiring during shipment. The dimensions of the steel panels with their supporting edges are the same as those of corresponding slate or ebony asbestos panels with supporting angles. The rounded edge of the steel panel matches the rounded edge on the next steel panel, or the ¼- or ⅜-inch bevel on the adjacent old panel.

The new panels are made in standard widths of 16, 20, 24, 28 and 32 inches, with a standard height of 90 inches.

Cutting Steel with Illuminating Gas

SINCE the adoption of illuminating gas to replace acetylene, hydrogen and other fuel gases in combination with oxygen for metal cutting, the General Electric Company, Schenectady, N. Y., has found many valuable uses for this new metal cutting tool. The accompanying illustration shows two operators in the Everett plant of that company cutting risers from a steel casting with



Cutting risers from a steel casting

oxy-illuminating gas torches. By this method a 19-inch steel riser is cut through in 7½ minutes.

The new method reduces gas costs, as the illuminating gas used is cheaper than either hydrogen or acetylene. The principal advantages claimed are availability; elimination of delays and handling of tanks; low cost; safety and chemical and physical properties permitting the use of the gas in a torch equipped with a superheater, thus effecting marked economies in the amount of oxygen required by the cutting jet.

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Diesel Electric Propulsion

Reply by the author to discussion of paper* read before the Society of Naval Architects and Marine Engineers

By W. E. Thau

OWING to the limited time available for reply to discussions, and also to the fact that some of the discussions required further thought and analysis before a suitable reply could be made, the following continuation of my reply has been prepared after the close of the meeting.

Mr. King has undertaken a very voluminous discussion of the paper which he closes with some remarks which are a very direct insinuation that the paper is misrepresentative, and which I think I am not in error in regarding as entirely inappropriate. I am thoroughly in accord with some of the statements made by Mr. King; however, their relevance to the paper does not seem obvious. Unfortunately, several of the statements in his discussion, particularly in regard to costs, are difficult, if not impossible, to check; for this reason, I think the discussion is lacking in force.

My paper describes a specific type of propulsive equipment, and relates the performance of this type in connection with the vessels to which it has been applied. The paper does not make comparisons with steam plant performance, except in two or three instances, such as the tug boat, the lake vessel in a specific trade and the fire boat, of which Mr. King has apparently taken advantage to vent feelings aroused by some one else. In listing in the paper the advantages of Diesel electric drive, my language did not preclude some of these advantages being common to other types of drive; notwithstanding Mr. King has devoted great space to showing that bridge control with the advantages derived therefrom is common to steam electric drive. In discussing a specific type of drive, I do not think that clearness requires that mention be made of every type of drive that may have a feature or advantage in common with the specific drive under discussion. I have stated in previous papers, which treated of the general subject of propulsion rather than a specific type of propulsion, that certain features such as bridge control, flexibility of plant utilization, etc., are the direct result of the system of electric transmission and applicable to any type of prime mover. Such features are obviously advantages of both steam electric and Diesel electric drive.

I am in entire concurrence with Mr. King in regard to the possibilities of the high pressure steam plant. There is much room for improvement in the economy of the present marine steam plant, and, if I have followed the developments rightly, I cannot help but feel that the progress made by the Diesel plant has furnished the impetus for the improvement in the steam plant. There is no controversy between us relative to the suitability of steam plants for propulsion. I have always maintained that each type of ship represents an economic problem in itself, and in this connection I quote the following from a paper which I presented before the Society of Naval Architects and Marine Engineers in 1921:

From the earning standpoint, "the factors of reliability, economy, weight, space, cost, operation and maintenance are involved in the propulsive equipment. Therefore, the type of drive best suited is that which excels in all, or the most important of these factors. The relative importance of these items varies with different ships, depending upon the trade route, cargo, etc., with the result that there is a definite and logical field for each of the principal types of drives such as reciprocating engine, geared turbine, turbine electric, Diesel and Diesel electric."

The success which will be obtained by high pressure, high temperature steam jobs is dependent on many factors, and it is hoped that the applications will be made with due respect to practical limits. I have a feeling that the limits in pressure and total temperature should be less than in the case of land plants. My observations have been that the high pressure, high temperature steam adds measurably to the cost of boilers, turbines and piping after certain values have been exceeded.

I will now take the liberty to point out a few of the things which probably prompted the paper on steam drive by Mr. King. In the second advantage under "Tug Boats," I conclude with the expression—"a characteristic unobtainable with any other system of drive." If the paragraph in which this appears is read correctly, it will be seen that this expression applies to the "system" utilizing the field control motor, and not to a "type" of drive.

In the concluding paragraph under "Lake Vessels" will be found a statement which probably brought down the "wrath of the gods." Here Mr. King quotes from the first sentence—"Fuel consumption of either direct Diesel drive or Diesel electric drive is so much better than that of comparable steam drives," whereas he would have done better to continue by quoting "that the slight difference between the two (Diesel electric and direct Diesel) is of little consequence." Had the paper's contents on this type of vessel, namely, lake vessels, been read as written, Mr. King would have noticed that the whole subject has reference to a specific class of lake vessel in a specific trade route, which excludes the ordinary lake vessel, and incidentally would have saved me as well as himself a lot of work. There is considerable danger in quoting only a portion of a statement, and certainly no excuse for distorting the meaning. I do not care to occupy the amount of space which would be necessary to explain the type of vessel with which I dealt, but to any one who has made a study of the special conditions under which these vessels operate, it will become obvious that the efficient type of steam plant which Mr. King has in mind would not show to nearly full advantage. The steam reciprocating engine is at a disadvantage because of the impracticability of employing high superheat and maintaining condensate free from lubricant. The steam turbine shows its best economy when operated at high speeds, and since a large portion of the route of these vessels involves canals and rivers containing approximately fifty locks, the great amount of slow running and maneuvering results in a net overall reduction in the turbine economy. It is very questionable whether steam of sufficiently high pressure and high temperature to produce the required economy could be used in an installation such as these where the horsepower is small and the load so decidedly intermittent. It is for these reasons that I was particularly careful to use the words "comparable steam drives." The statement as written applies to a special class of ships, and not to lake or ocean ships in general. As stated before, I

* Mr. Thau's paper on "Diesel Electric Propulsion" was published on page 701 of the December, 1926, issue of MARINE ENGINEERING AND SHIPPING AGE and an abstract of the discussion on page 724 of the same issue.

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fully realize the possibilities of high pressure, high temperature steam, but, at the same time, to use Mr. King's words, I would not regard it as a "panacea for all of our engineering ills."

The third place, where I have referred to a comparison with steam to illustrate a performance, was in connection with the fire boats. Here I am inclined to fear that Mr. King has been given much data which is based on feeling rather than fact. I have just completed a very thorough investigation in regard to steam fire boats. The results of this investigation are at pronounced variance with most of the figures given by Mr. King. However, before entering a discussion of this subject, it must be distinctly understood that machinery costs and boat costs are not synonymous terms, and that we cannot compare machinery by comparing boats. Since we are interested in machinery, its operation and installation, we must not permit the cost of the boat, where uninfluenced by the machinery, to confuse the issue. Mr. King cites the *Port Houston* in comparison with a few selected steam fire boats. The *Port Houston*, as a matter of fact, has many features not contained in all fire boats, and, therefore, the cost of the apparatus foreign to the propelling machinery was more than is the case on the ordinary fire boat.

I do not feel privileged to burden this discussion with details of that nature, and, therefore, refer those who are interested to the next issue of the *Proceedings of the American Association of Port Authorities*, where a full discussion of this subject will be found. Suffice it for this discussion to state that the average machinery space personnel cost of typical oilfired steam fire boats is $18,525 per year including those of Philadelphia (the lowest) and New York (the highest). The actual yearly fuel cost of these same boats is $5,500. Similar figures for the *Port Houston* are $9,240 yearly, machinery space personnel cost; and $2,000 per year for fuel on the basis of the same pumping capacity as the steam fire boats just mentioned. The difference in these two items alone at 15 percent carrying charge amounts to $85,000 capitalization, which in reality is the amount that can be paid for the more expensive machinery over and above the cost of the steam plant. The machinery space personnel costs which Mr. King gives for the *Deluge* (New Orleans), and the *Moore* (Philadelphia), although lower than figures which I have obtained on the same boats, are as a matter of fact the two lowest of all the principal cities in the United States operating fire boats. It is hazardous to work with insufficient information.

The average power available for propulsion while operating the pumps at full capacity is approximately 23½ percent when considering eleven typical steam fire boats of the principal cities. None that I have investigated will produce more than approximately 50 percent power on the propellers while pumping at full capacity, even though the boilers be forced to maximum capacity. This means that we cannot consider the steam fire boat as an institution in which all of the connected load can be operated at full power simultaneously. On the basis of the total power actually simultaneously available, the machinery weight of the steam fire boat *Mitchell* is 0.15 ton per horsepower, and of the *Port Houston* is 0.14 ton per horsepower. These figures contemplate operating both to the maximum capacity. This does not bear out the statement that Diesel electric drive would weigh 65 tons more than the steam machinery in the case of the Philadelphia boats as stated by Mr. King. The question is, what Diesel engine was considered?

The figures in the table on Fire Boat Data given by Mr. King are at variance in many instances with figures which I have obtained. For instance, the *Mitchell's* machinery cost $129,000, whereas the *Port Houston's* machinery cost $136,000. Comparing this on the basis of power simultaneously available for propulsion and pumps when forcing the boilers to their maximum, and overloading the Diesel engines 10 percent, we have:

Fire Boat	Maximum Power Available	Cost per H. P. Simultaneously Available
Mitchell	1467 horsepower	$88.00
Port Houston	1010 horsepower	134.50

I am unable to follow Mr. King's data in connection with the 2,500 shaft horsepower and the 7,000 shaft horsepower cargo boats which he cites. In the case of the 2,500 shaft horsepower vessel, it is not stated whether the 35 percent increase in cost refers to the ship or to the machinery, and furthermore no data are given to check the percentages of gain and loss which he gives. If the situation is as he states, why are approximately 50 percent of the new vessels, particularly in Europe, equipped with Diesel machinery?

In the case of the study of the 7,000 horsepower ship, Mr. King states that the cost of the Diesel electric plant with auxiliaries was more than $700,000 in excess of that of a complete steam plant using geared turbine machinery. Presumably the $700,000 includes auxiliaries as well as propelling machinery. Also since he mentions this ship under "Cargo Ships," we can assume it is a cargo ship. Neglecting the independent auxiliary equipment, a 7,000 shaft horsepower Diesel electric drive should be bought for approximately $850,000 including a 100-kilowatt standby auxiliary plant. Taking Mr. King's figure of $700,000 additional for the Diesel electric plant, would indicate that the steam plant would cost $150,000, or $21.43 per shaft horsepower. Later he states that a modern steam plant could be installed in the U. S. Shipping Board vessels for $90 per horsepower. It is difficult to segregate the cost of installation and the cost of machinery. However, the installation would hardly cost the difference between $90 and $21.43 per horsepower even considering that the drive in one case is nearly three times as large as that in the other case.

Later, the carrying charge for $700,000, which was given as the additional machinery cost of Diesel electric as compared with steam in the case of the 7,000 shaft horsepower vessel, is stated as $75,000 per year. If the rate of charge is 15 percent, as was used in the case of the 2,500 shaft horsepower vessel, the $75,000 represents an additional investment of $500,000 and not $700,000.

It is difficult to comprehend wherein such figures warrant the appellation "Data."

With reference to large passenger vessels, my paper merely pointed out the feasibility of Diesel electric drive and suggested its consideration. It is true enough that in such installations the improved steam plant will make its best competitive showing because of better personnel, large capacity, etc. The Diesel electric drive also has possibilities even for this class of vessel, and should be considered in the design of large passenger vessels.

With reference to Mr. Beekmans' discussion, I wish to correct a figure which appears on page 2 of the paper. The figure of 65 percent speed obtainable with one armature of a double armature motor is slightly in error, and should be 70 percent instead of 65 percent, as stated (but not 80 percent as Mr. Beekman states). I do not understand the experience which Mr. Beekman claims indicates to them that, with a suitably designed motor, 80 percent speed is obtainable in practically all cases. Eighty percent speed on the basis of the cube law means half power, and, as I pointed out previously, a motor of normal design, to develop full power, must be operated at full speed. Seventy percent speed corresponds to approximately 35 percent power on the cube law basis, and since one armature represents only 50 percent of the total power, 35 percent power at 70 percent speed is the output corresponding to full power reduced in the ratio of the speed, which is normal perfor-

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mance for a normally designed motor. For one armature to deliver half power would necessitate an initial unit having capacity at least 25 percent in excess of the full power equivalent.

With reference to the communicated discussion received from Mr. Charles Rettie, in which he requests the reason for the United Fruit Company not carrying out its program in Diesel electrifying the three fruit ships, as was contemplated, I regret that I am unable to answer him with definite knowledge. It is my understanding, however, that some trouble was experienced with the engines and that the electrical equipment performed satisfactorily. Since I do not have first hand knowledge of this situation, I would suggest that Mr. Rettie make his request of the United Fruit Company. For his ease of mind, however, I can definitely state that whatever trouble existed is by no means assignable to the system of propulsion, that is, Diesel electric drive. The success which has attended the installations made in this country is established beyond question, and has proven the soundness of the system.

With reference to Commander Gatewood's discussion, I rather feel disinclined to discuss the situation in the public press. I have some very definite ideas relative to the overall comparison of direct drive Diesel and Diesel electric for cargo vessels, particularly in regard to cost and weight, but consider it preferable not to discuss the matter through this medium.

Discussion on Diesel Electric Drive

By F. L. Du Bosque*

I THOUGHT it might be appropriate, in that neither Mr. Thau nor Mr. King has given any definite information as to relative fuel consumption of the Diesel engine driven type, as compared with the steam engine propelled tug, to furnish some data on this subject.

For the past two and a half years we have had in operation a Diesel electric tug and with an oil fuel cost of five and a half cents per gallon, the cost per day of twenty-four hours of fuel is $27.50. We have quite a number of steam engine driven tugs of exactly the same horsepower, doing the same work, and the cost for coal as fuel at $7 a ton, which is about the harbor rate, is $49 per day.

Some years ago, when oil for fuel became rather popular, quite an exhaustive service test was made of the relative costs of oil and coal for fuel in tugboat service. The oil at that time cost five cents per gallon and the cost for fuel was $35 per day of twenty-four hours; so you have a comparison of fuel cost in tug boat service of $49 for the steam driven tug using coal, $35 for a steam driven tug using oil and $27.50 for the Diesel electric drive tug using Diesel fuel oil.

When we find something that has been very successful in any one field we are very apt to reach out and apply it to almost every other. The suggestion was made two years ago that the Diesel electric system was most appropriate for tug boat service and the experience of the last two and a half years has proven this to be a fact. Many of the advantages could be enumerated. It has one particular advantageous feature not found in the "so called" straight Diesel drive. The power given out by Diesel engines is related to two factors, the mean effective pressure and the piston speed or revolutions per minute. The Diesel engine is usually rated on a maximum mean effective pressure which may be considered constant, the power in each engine therefore depends upon the piston speed or revolution. In the Diesel electric system the piston speed and mean effective pressure do not vary, so that full power is delivered to the generators at all times. On a tug boat engaged largely in tows the speed of revolution of the screw when towing may be taken at about 70 percent of the free running speed, and it follows, therefore, that, when towing, the Diesel engine straight drive system is capable of delivering only 70 percent of its full power to the screw. With a properly designed propelling electric motor, full power can be absorbed and delivered to the screw with equal efficiency at this reduced speed of revolution. It is very evident therefore that with a Diesel electric system full power can be delivered to the screw when towing as well as when running free and that the system is able to deliver to the screw at least 25 percent more power than the straight Diesel drive system.

There is another feature where the Diesel system is of considerable advantage, touched on by Mr. Thau to some extent, and that is where the tug is equipped with a great number of auxiliaries. In preparing the designs of a tugboat of the seagoing type a short time ago, we were inclined to adopt the straight Diesel system, but from the analysis made of the power required to drive the various auxiliaries, which this tug required, and with the necessary source of energy, it was found that the Diesel electric system was the cheapest to install, and it had the further advantage, as above described, of being able to deliver full power to the screw at all times.

This tug is unique in the fact that electric energy is used for every purpose, including cooking, refrigeration and heating.

*Superintendent of Floating Equipment, Pennsylvania Railroad, New York.

Welding Tank Seams Automatically

THE welding of longitudinal seams on tank drums or pipe is being successfully performed by a special tool designed by the Westinghouse Electric and Manufacturing Company. This tool, which will hold material of any length up to and including 8 feet, and from 10 inches to 40 inches in diameter, consists essentially of a travelling auto arc and a suitable cast steel framework for carrying the auto arc and for holding the material which is to be welded in place.

The section of the pipe or tank drum that is to be welded is easily put into place between the two sections of a clamping device, which is in the form of an extended arm balanced by a cast steel base. The lower half of the clamping device contains air cylinders, and a copper backing-up strip. After the material has been placed in proper position so that full penetration can be obtained when the auto arc passes across it, the operator throws a handle located at the extreme left of the extended arm. This releases the air which raises the air cylinders and presses the copper backing strip against the pipe, holding it firmly in place.

The auto arc, which is placed at the beginning of the seam to be welded, is mounted on a travelling carriage consisting of four grooved wheels similar to a trolley wheel, which move along a grooved track on the extended arm of the tool. The auto arc is propelled along this track by means of a ¾ horsepower motor mounted on the auto arc base, and which is geared to the wheels of the travelling carriage. When the operator is ready to begin the operation he merely throws a switch to start the motor and another one to start the auto arc. The auto arc then moves along the seam, automatically welding it. The motion of the auto arc can be reversed at any moment and any irregularities in the seam can be cared for by means of a hand wheel which the operator regulates so as to keep the welding wire directly on the seam.

With this automatic seam welder, tank drums of 16 gage up to ⅜ inches in thickness can be welded at speeds from 14 to 25 inches per minute.

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How to Handle Wire Rope

Practical instructions, supplied by the American Cable Company, tell how to splice, seize and socket wire rope

IN order to prevent appreciable loss of strength at the splice, it is customary to make the splice not less in length than that given in the table below for ropes of different sizes:

Diameter of Rope	Length of Splice
½ inch	15 feet
⅝ inch	20 feet
¾ inch	24 feet
⅞ inch	28 feet
1 inch	32 feet
1⅛ inch	36 feet
1¼ inch	40 feet
1½ inch	45 feet

In splicing the two ropes, fasten the ends so that they overlap, allowing for a splice of from 15 to 45 feet, as indicated by the above table. For purposes of explanation we will assume a 30-foot splice. First wrap or tie the ropes securely with iron wire 30 feet from each end, then unlay

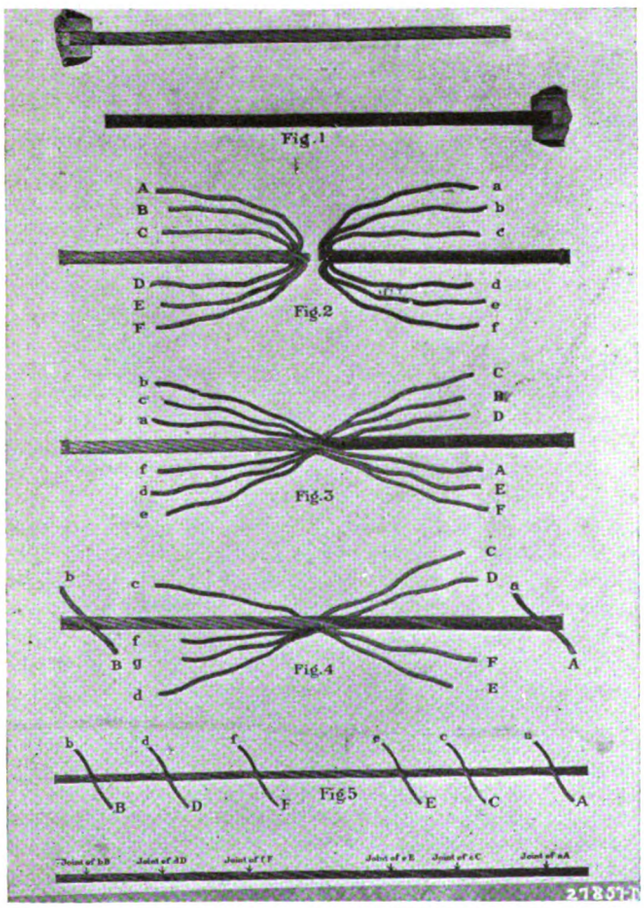

Plate I.—Illustrating method of splicing wire rope

all strands 15 feet as shown in Fig. 2 of Plate I, cutting away the hemp core to permit bringing the two unstranded ends together so that the strands will interlock as in Fig. 3.

Take strand *a* and unlay it until the wire binding is reached, then in the open groove place strand *A*. Lay *A* in tightly as shown in Fig. 4, making the twist agree exactly with the twist of the open groove. Proceed in this way until all except 2 feet of *A* are laid in, then cut off *a* and *A*, leaving the ends about 2 feet long. Now unlay strand *B* in the opposite direction and in its place put strand *b*, stopping the ends of the rope in the corresponding position to A, Fig. 4.

Subsequently c will be replaced by *C*, but this should be stopped 6 feet short of the junction of *A* and *a*, as shown

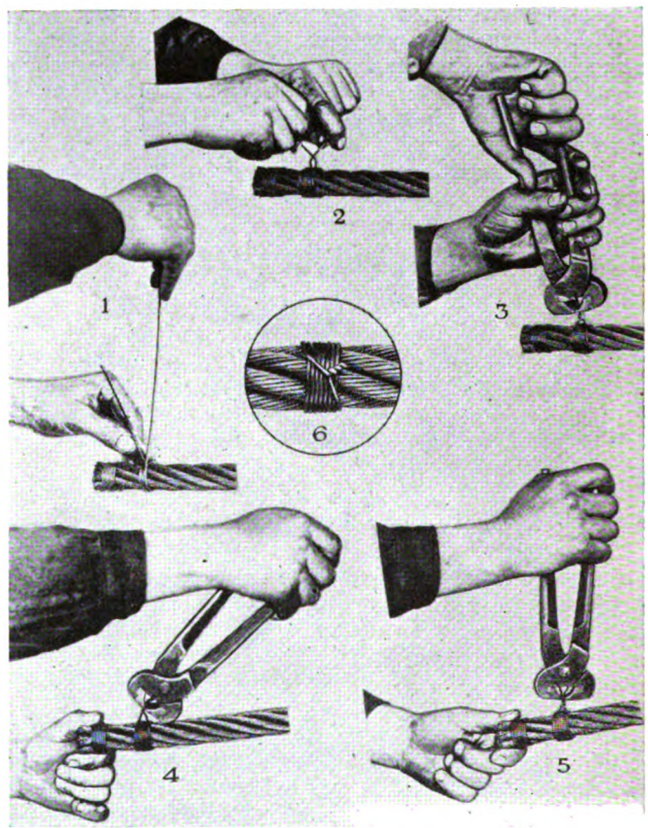

Plate II.—Proper method for seizing wire rope

in Fig. 5. Similarly, *D* should be replaced by *d* and the end stopped 6 feet short of *Bb*.

Proceed similarly with *Ee* and *Ff*, stopping the ends 6 feet short of *Cc* and *Dd* respectively.

The rope will now present the appearance shown in Fig. 5 and the only remaining step is to tuck in the ends in such a way that the diameter of the rope will not be enlarged where the ends are tucked in. This is done by removing the hemp center and putting the ends of the strands in the place previously occupied by the core. To do this, it is first necessary to open or untwist strands *Aa* so that the hemp center can be seized with a pair of pliers and pulled out. Then a marline spike is inserted to keep the gap open. After starting the loose ends into the space left vacant by the removed core, rotate the marline spike so as to force the strand into place.

Upon completion hammer the rope lightly with wooden

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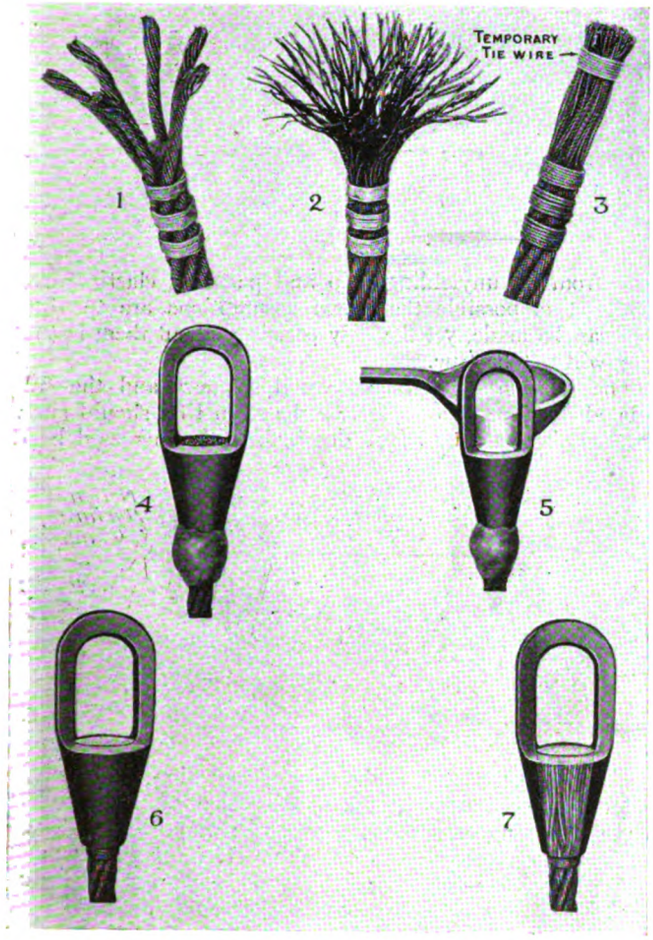

Plate III.—Showing how to resocket wire rope

or copper mallet, in order to assure a uniform diameter throughout the length of the splice.

How to Seize Wire Rope

The end of an ordinary wire rope should have at least three seizings to prevent unlaying, which, if it occurs, would render the rope useless. The seizings may be replaced by fittings if they are designed to prevent unlaying of the rope.

1—Wind the seizing wire on the rope by hand, keeping the coil together and considerable tension on the wire, winding over from left to right as in Fig. 1 of Plate II.

2—Twist the ends of the wire together counter-clockwise by hand so that the twisted portion of the wires is near the middle of the seizing.

3—Using Carew cutters, tighten the twist just enough to take up the slack. Do not try to tighten the seizing by twisting.

4—Tighten the seizing by prying the twist away from the axis of the rope with the cutters.

5—Tighten the twist again as in 3. Repeat 4 and 5 as often as is necessary to make the seizing tight and rigid. Cut off the ends of the wires, and pound the twist flat against the rope.

The appearance of the finished seizing is shown in Fig. 6.

Any annealed low carbon steel wire may be used for seizings, the size ranging from No. 10 to No. 18, depending upon the diameter of the rope. This method is taken from the United States Government Master Specifications No. 297.

How to Socket Wire Rope

In socketing a wire rope, measure back from the end of the rope a distance equal to the length of the tapered basket of the socket. Tie securely at this point with soft iron annealed wire and add two additional tie wires below the first.

Open up the strands as in Fig. 1 (Plate III) and cut out the hemp core as far down toward the tie wire as possible. Unlay each wire and straighten so as to form a "brush" as in Fig. 2. On large ropes and heavy wires it would be necessary to place a small pipe over each wire to straighten or approximately remove the curl from the wire.

If the wires are very greasy, hold the "brush" over a pail of gasoline (with the wires held downward) and wipe off the grease with waste or a paint brush dipped in the gasoline. Wipe dry, using a clean rag or piece of waste.

Dip the "brush" still holding the wires point down, into a pot of muriatic acid solution (50 percent water and 50 percent commercial acid). Insert the brush to a depth so as *not* to immerse the end of the hemp core. Keep in the acid until the wires are clean. Still holding the wires downward, withdraw from the acid and knock the rope sharply with a stick (broomstick or hammer handle).

Place a temporary tie wire as in Fig. 3 over the ends of the brush taking care not to handle the cleaned wires with greasy hands or tools.

Insert the rope end into the socket, then cut the temporary tie wire.

Set the rope vertically in a vise; adjust the socket so that the wires come flush with the top of the basket of the socket, then spread the wires out. Seal the bottom of the socket with fire clay or asbestos, as in Fig. 4. (If cold, warm the socket moderately.)

Pour with pure zinc (not babbitt, lead or other alloy) as in Fig. 5. Tap the side of the socket with light hammer while the zinc is still fluid, so as to jar the zinc into crevices between the wires. When cool, remove the fire clay and the serving wires, and the joint as per Fig. 5 will result. It will help slightly in the flowing of the zinc among the wires to put a small quantity of salammoniac crystals over the wires just prior to pouring the zinc. Fig. 7 shows a phantom view of the zinc cone with imbedded wires.

Stern Shoe of U. S. Coast Guard Cutter Carrabassett Repaired by Thermit

TWO Thermit welding jobs were made recently at the Maryland Dry Dock Company, Baltimore, Md., on the U. S. Coast Guard cutter *Carrabassett* and the S.S. *West Cobalt* of the Shipping Board.

The weld made on the *Carrabassett* was on the stern shoe that was broken just aft of the stern frame through a section 4 inches by 14 inches, and the weld on the *West Cobalt* through a section 9 inches by 21 inches in the lower gudgeon of the rudder post.

Both welds were successfully carried out under the direction of the Metal & Thermit Corporation's operator in a limited amount of time as it was necessary to float the ships as soon as possible.

AMERICAN SHIPS SUPPLY THE WORLD.—In 1868 there were 3,067 vessels of the American merchant marine engaged in foreign trade and in 1926 there were 4,616 ships so engaged, according to Merchant Marine Statistics for 1926 made public by the Department of Commerce. The tonnage of American ships engaged in foreign trade amounted to 7,719,139 gross tons on June 30, 1926. During the year 1868 there were 22,531 ships engaged in coastal trade and last year there were 21,203.

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An Unusual Launching Observation

Method devised for determining the distance traveled by the ship when the stern starts to rise

By John P. Comstock and James A. Pennypacker

At the recent launching of the Matson liner *Malolo*, at the yard of the William Cramp and Sons Ship and Engine Building Company in Philadelphia, a description of which was published in MARINE ENGINEERING AND SHIPPING AGE for July, 1926, observations were taken to determine the distance traveled by the ship when the stern started to rise. It was hoped that this information would throw light on certain launching characteristics which are calculated by very conventional methods: the fore-poppet pressure at pivoting, the minimum moment against tipping, and the maximum way-end pressure. The calculations for all of these assume "static" conditions, that is, an infinitely slow launch, with level water and no dynamic effects, and the calculation for the way-end pressure also assumes straight-line distribution of the land-borne weight along the length of ways still in contact, which could result only from an unyielding ship and perfectly elastic ways. While it is possible that these assumptions are the best that can be made, yet the only certainty about them is that they will not be true.

The relation between the actual distance and the calculated distance traveled before the stern lifts should show whether the extra buoyancy due both to the increased head of the stern wave and to the dynamic reaction of the water being displaced would more or less than offset the effect of the hogging of the ship over the way-ends and the effect of the momentum of the ship. If more, the moment against tipping would be greater and the way-end pressure less than the calculations would indicate, thus perhaps rendering expensive precautions unnecessary; if less, the displacement would be greater and consequently the poppet load less than that calculated.

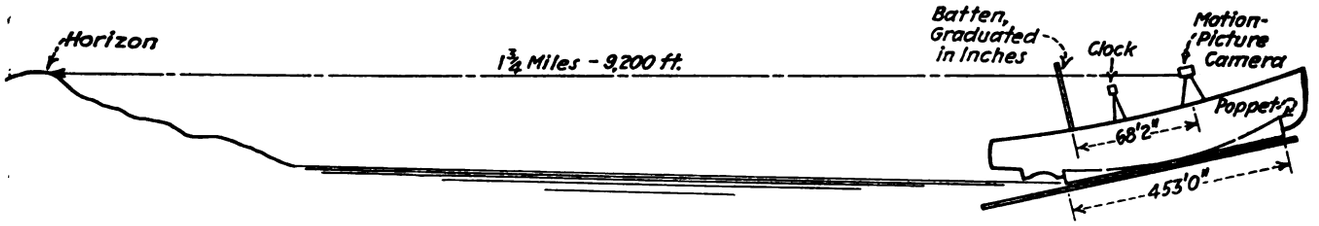

Fig. 1.—Sketch showing apparatus used

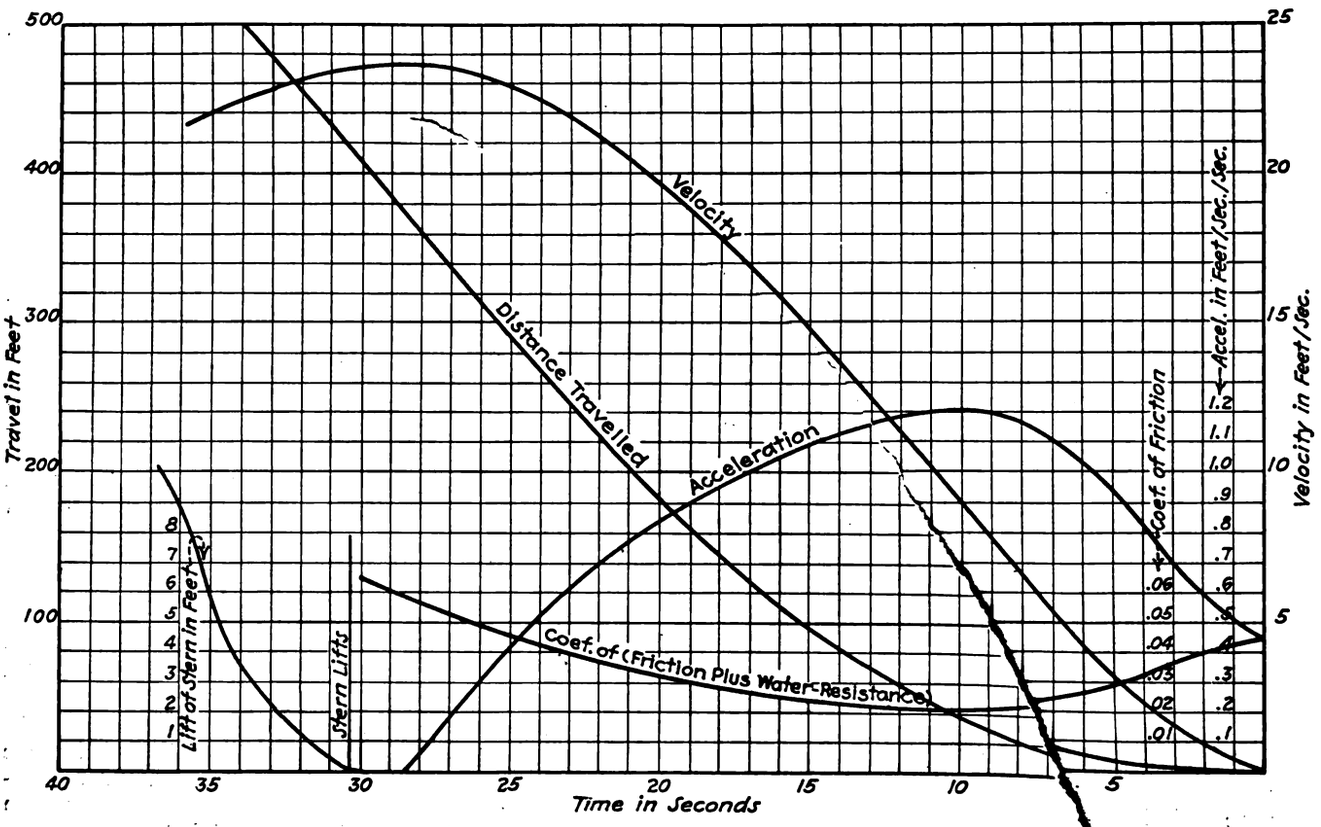

Fig. 2.—Time-distance data

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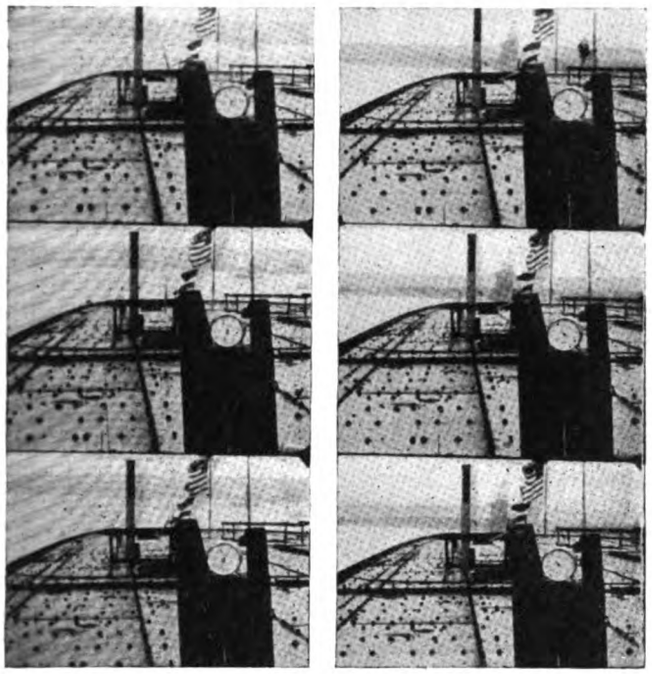

BEFORE LIFTING AFTER LIFTING

Fig. 3

A means of experimentally determining the actual way-end pressure experienced would be even more illuminating. No feasible method of doing this is known to the writers. Any suggestions would be welcome.

The apparatus used to find the distance traveled before the stern lifted, and incidentally the complete path of the stern of the ship from the start to the drop-off, is illustrated in Fig. 1. The line from the camera to the horizon was used as a line of (practically) unchanging direction; and the pictures showed the intersection of this line with the graduated batten. The clock, an Eastman exposure-timer, showed the time. The camera took sixteen pictures per second. The time-distance data were obtained on the ground by means of the chronograph described in MARINE ENGINEERING AND SHIPPING AGE of June, 1922, and are plotted in Fig. 2.

The camera was started during the sawing-off, with the shutter closed; the shutter was opened at the instant that the ship started. To definitely check the time showed by the clock with that recorded by the chronograph, two light sticks were set up in the field of the camera and tied to cords led over the rail and tied to two of the chronograph stops, so that when the ship had traveled to these stops, the sticks were yanked down. The first of the two sections of film illustrated (Fig. 3) shows one of these sticks going over. A comparison of the two sections of film will show how the batten lifted against the horizon.

Seeing the picture as thrown on a screen by a projector

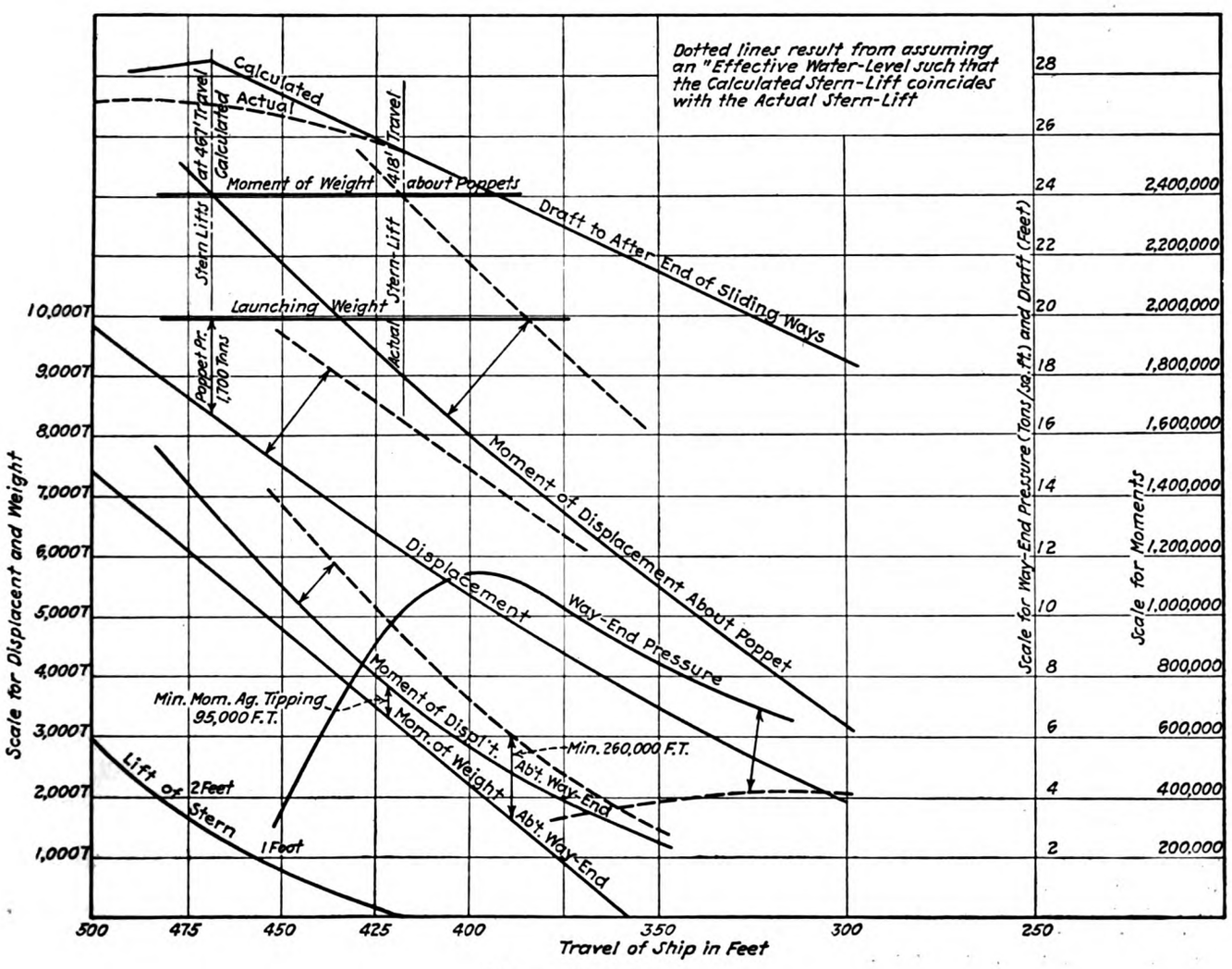

Fig. 4.—Launching curves

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proved interesting but not instructive. It was found necessary to mount the film on two reels, under a strong magnifying glass, so that any one picture could be studied at will. These observations gave the curve shown on the launching curves, Fig. 4, and the lift of the stern. As the ship went down the ways, the horizon very slowly rose on the batten, due to the lowering of the ship. The amount of this was calculated and allowed for in working up the results. When the stern lifted, the horizon dropped rapidly on the batten. Knowing the three distances shown in Fig. 1, the path of the stern all through the launch was determined.

The launching curves of interest here are shown in Fig. 4. Apart from the results of these observations, they are in no way unusual, but it will be noted that the actual stern lift occurred 49 feet sooner than the conventional calculations indicated, and that the maximum draft at the after perpendicular was correspondingly less. The probable explanation of this rather surprising result seems to be that the combined effect of the buoyancy of the stern wave and the increased pressure due to the inertia of the displaced water far over-balanced the opposing tendencies. The pier each side of the building slip was 4 feet 1 inch above still water, and as the bulk of the ship entered the water, the water rose over the top of the pier. A rise in effective water level of 2.84 feet would have moved the point of stern lift 49 feet ahead, and if it be assumed that the "effective" water level was that which would bring the calculated stern lift to the actual stern lift (2.8 feet above still water), the moment against tipping would have been increased from 98,000 to 260,000 foot-tons, and the way-end pressure would have been decreased from 11 to 4 tons per square foot. These effects are large enough perhaps to be deciding factors in considering the advisability of lengthening the under-water ways or of providing internal reinforcement over the way-ends, matters which might involve considerable expense.

It must be recognized that no definite conclusions whatever can be drawn from one launching. This one might have been the exception rather than the rule. But if results consistently similar to those described here should be found in a number of cases, there would be some justification for allowing for them. It is hoped that similar observations will be made of several launchings until they reveal whether or not any of this increased buoyancy can confidently be expected and taken advantage of in making launching arrangements.

Rego Welding and Cutting Equipment

IN emergency ship welding, both for naval and merchant vessels, Rego welding and cutting equipment, manufactured by the Bastian-Blessing Company, Chicago, Ill., has been found particularly useful. During recent maneuvers of the United States fleet several accidents occurred in the destroyer squadron that demanded immediate repair. Several Rego outfits were carried by vessels of the fleet and with the aid of these in making condenser, torpedo tube, boat davit and numerous other repairs certain of the destroyers were able to continue in the manuevers. Rego welding equipment is also standard for the Puget Sound Navy Yard. The cutting torch has been utilized here in salvage work and for cutting up armor plate.

The range of torches particularly adaptable for ship and shipyard use include a general cutting outfit which has a capacity up to 12-inch steel. This outfit, in addition to the torch, includes 5 pure drawn copper tips. The regulators are built to allow a free flow of large volumes of gas. The hose is armored to prevent damage from flying sparks and metal.

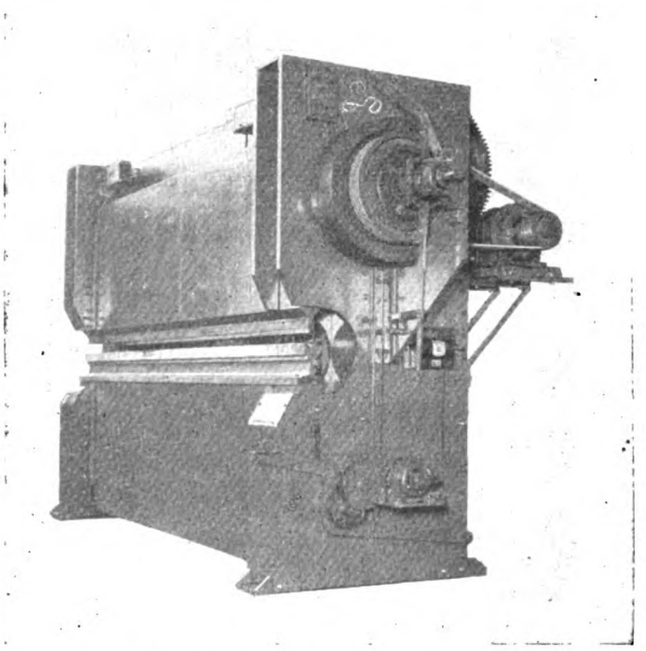
A general cutting and welding outfit, which utilizes medium pressure oxy-acetylene gas, contains a cutting torch with 5 pure copper tips which will cut steel up to 12 inches and a welding torch having two mixers and 8 copper tips for general welding service. In a medium cutting outfit for steel up to 3 inches, which uses medium pressure gas, the torch is made from a special non-bending alloy and the head and end valves are of forged brass.

Two other types of torches are also useful in ship work, i.e., a general welding and emergency cutting torch and a heavy duty welding torch each having a complete range of mixers and tips for all classes of work. The Bastian-Blessing Company manufactures a complete line of accessories for cutting and welding, tanks, regulators of tips, brazing torches, soldering torches, trucks, hose connections and the like.

Heavy Duty Bending Brake

THE Dreis & Krump Manufacturing Company, Chicago, Ill., manufacturers of steel up and down press brakes for sixteen years, has recently added to its line a toggle motion double housing gap press brake for heavy bending or multiple bends in one stroke.

It is claimed that the toggle motion increases the pressure at the bottom of the stroke where the final bend is made. A direct motor to flywheel drive consists of the Allis-Chalmers Texrope with cast iron sheaves, one sheave being mounted on the clutch rim on the flywheel and one sheave on the motor. The flywheel turns on Timken roller bearings. A bronze ring is mounted on an eccentric which is shouldered into the bull gears. This eccentric actuates



Double housing gap bending press

steel connection straps which drive against the toggles and operate the ram, the toggles being bronze lined throughout. The toggles are so located that they do not completely straighten when the ram is down and thus eliminate the possibility of the ram being jammed on dead center when too close adjustment is made.

The adjustment for various heights of dies and thickness of metal is controlled by a small independent reversible motor furnished with the machine. This operates reducing spur gears and worm gears, the worm gear acting as a nut to raise or lower a screw supporting the bed. The adjustment can be made independent at each end or in unison as

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may be required. Each housing is constructed of two steel plates spaced with heavy channels and between which the bull gear, eccentric, toggles and driving gears operate. Each housing has an independent driving unit mounted within, these units being connected with a drive shaft on which the flywheel and clutch are mounted. A Madison-Kipp oiler, forced feed, provides lubrication to bearings and slides.

These machines are made in various lengths and capacities up to 14 feet in length and to bend up to ½ inch steel plates.

Pure Feed Water*

ON all types of steamships, no matter what form of boiler is employed, it is a matter of considerable importance to ensure that the feed water shall be as pure as possible. With the ordinary form of cylindrical return-tube marine boiler the presence of a small amount of "salt" in the water—the word "salt" being used in this connection to indicate not merely the chemical sodium chloride, but any substance which may be dissolved in the water—is not of vital importance. The salt will, of course, be gradually deposited on the surface of the tubes and the combustion chambers, but, generally speaking, such boilers are not very hard to scale and the desposits can be periodically removed. The presence of scale will necessarily decrease the amount of heat which is conducted through the heating surface to the water and it may lead to overheating of the plates or the tubes, but provided the deposits are not allowed to become of excessive thickness little risk is involved, neither will the efficiency of the boilers be very greatly reduced. Where superheaters are installed in conjunction with boilers of the conventional design, then the problem of salt in the feed water assumes a far greater importance, since the salt is very liable to be transmitted to the superheater elements through the moisture in the steam, and becoming deposited on the interior surface of the elements as this moisture is evaporated, may rapidly lead to overheating and eventual burning out of the elements. It is not too much to say that the difficulty of eliminating all traces of salt from the feed water has been almost entirely responsible for the limited measure of success which has attended the use of superheated steam on a number of large passenger liners, and hence from the point of view of obtaining the fullest advantage of the economy in fuel consumption which the use of superheated steam renders possible, it is highly desirable that the feed water should be maintained in a state of absolute purity if this is at all possible.

Watertube Boilers Must Have Pure Water

The use of higher steam pressures and the consequent tendency to adopt the watertube boiler on board ship adds very considerably to the necessity for obtaining pure feed water. Apart altogether from its effect in the superheater elements, to which we have referred above, the presence of salt is likely to have a very serious effect upon the heating surfaces of the boiler itself. In the watertube boiler, owing to the superior circulation of the water and its far greater steaming capacity, the rate of heat transmission through the heating surface is far greater than in the ordinary type of marine boiler. Moreover, the tubes being much smaller in diameter are also of smaller thickness and hence the effects of overheating, due to the accumulation of scale on the water side, will be correspondingly severe. Thus, with the small tube watertube boiler, it is absolutely essential that the possibility of impure feed water entering the boiler should be entirely eliminated. We have already seen on the *King George V* how by the fitting of twin condensers and by other precautions it is hoped to maintain the feed water in a state of absolute purity, and while in future high pressure installations the same elaborate precautions may not be taken, it is certain that the problem will have to be most carefully considered. It will hardly be considered sufficient, as is the case with ordinary marine type boilers working at moderate pressure, to ensure the necessary degree of purity by adding lime or some other form of water softening substance, occasionally blowing down the boilers and using distilled water from the evaporators for feed make-up purposes. Steps will undoubtedly have to be taken to trace the source of contamination, which in the majority of cases will be found to be the condensers, and thence means must be devised for dealing with the problem at its source.

Successful Method of Treating Feed Water

But while numerous attempts have been made to deal with the contamination of feed water on board ship by eliminating, or at least minimizing, the possibility of leakage of sea water into the condenser—the system adopted on the *King George V* is a case in point—these have not hitherto met with any wide measure of acceptance, and a more hopeful method appears to be to treat the feed water so as to render any solid matter which it may contain non-adhesive when it enters the boiler. This process has already been successfully employed on board ship, a soluble constituent of linseed oil being introduced into the feed water before it enters the boiler. This has the effect of bringing down the solid matter in a non-adhesive form inside the boiler, whence they can be easily removed, while the surface of the plates, tubes, etc., remain perfectly clean. From experiments made on vessels at sea with feed water containing large quantities of scale producing substances, and even when using sea water for boiler feed purposes, it has been shown that this process does prevent the formation of scale in the boilers and, moreover, it tends gradually to remove the old scale which existed inside the boiler prior to the application of the process. We do not know if the process has been applied to watertube boilers on board ship, but there appears to be no reason why it should function differently in boilers of this type to what it does in the ordinary cylindrical type of boiler, in which case it might be suggested that, while still taking every precaution to ensure that the feed water shall be as free as possible from contamination, the use of some such process as this might enable the watertube boiler to be used on board ship without any fear of the formation of scale inside the boilers and tubes with its attendant evil effects.

[EDITORS' NOTE: The above process is handled in the United States by the Filtrators Company, 96 Liberty street, New York, and an illustrated description of the process was published on page 640 of the November, 1925, issue of MARINE ENGINEERING AND SHIPPING AGE.]

* From *Shipbuilding and Shipping Record*.

Foreign Seamen Outnumber Americans in the American Merchant Marine

NATIVE American seamen shipped and reshipped by Shipping Commissions on vessels in the American merchant marine from United States ports numbered 98,493, according to merchant marine statistics for 1926 just announced by the Department of Commerce.

British nationals were second in order of number with 28,011. Naturalized Americans shipped during the year are given as 26,280 followed by Germans, 18,375; Spanish, 12,896; Norwegian, 7,108; Filipino, 5,252; South Americans, 5,184; Dutch, 4,573. Nationals of China, Russia, Italy, Japan and other countries are included in the total figures of 235,276.

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Questions and Answers for Operating Engineers

Practical information for marine engineers on the operation and maintenance of boilers, engines and auxiliaries

This department is maintained to help those who desire practical information regarding engine room problems or who are preparing to take examinations for a marine engineer's license. Readers are urged to send in questions. Inquiries bearing the name and address of the writer will be answered promptly by mail. If the question is of general interest the answer will also be published in an early issue of the magazine, although the identity of the writer will not be disclosed in doing so. Anonymous communications will not be considered.

Compound vs. Single Engine

Q.—What would be the advantage of a compound engine running non-condensing over a single engine of the same horsepower?

A.—The compound engine would be more economical due to a greater expansion of steam.

Pressure on Piston

Q.—If a steam gage shows 30 pounds and the vacuum gage 26 inches, what pressure would be on the piston?

A.—As 26 inches of vacuum equals 13 pounds, you would have 30 pounds + 13 = 43 pounds pressure.

Duties of Engineer During Survey

Q.—What are the duties of an engineer, prescribed by law, when boilers and machinery are under survey?

A.—He must assist the inspector and point out all defects in machinery, boilers and throughout the ship.

Boiler Repairs

Q.—What are the duties of an engineer in regard to repairs that may affect the safety of a boiler?

A.—The engineer should report the repairs made to the nearest local inspector and owners and recommend what he considers the best repairs to be made for the following trip.

Double Ported Slide Valves

Q.—Why are double ported slide valves sometimes used?

A.—They save weight and space and reduce the travel of the valve by one-half by giving admission at each end. They are generally used on low pressure engines.

Precautions to Be Observed in Using Fuel Oil

Q.—What care should be taken in ships burning fuel oil and what are some of the reasons of oil fires and explosions on board ships of this class?

A.—Fuel oil is non-explosive, very difficult to light in bulk and not even capable of spontaneous combustion, but the vapor from this class of oil is very explosive when mixed with air. Therefore great care should be taken in regard to leaks, opening tanks, keeping bilges clean, vent pipes to tanks kept clear, and above all carelessness.

Ignition of this vapor can be caused by using open lights, smoking, spark from galley funnel, electric welding, gasoline torches, burner going to work close to an empty tank before a chemist passes on tanks, and possibly from the heat of the filament of a broken electric bulb, especially when using portable lights while doing a job around bilges or opened tank.

Density of Water in Boiler

Q.—How do you find the density of the water in a boiler?

A.—By the salinometer.

Allowable Error in Water Meter

Q.—What is considered to be the allowable error in a water meter?

A.—A meter is considered satisfactory if it shows an error of not more than plus or minus 3 percent.

Mesh for Forced-Lubrication Strainers

Q.—What is the proper mesh for forced-lubrication strainers?

A.—The Navy Standard is 30-mesh of 0.016 wire for discharge lines and 8-mesh of 0.047 wire for suction lines.

Why Brazed Pipe Joints Fail

Q.—What can you suggest as the reason for repeated failure of the braze where one pipe joins onto another?

A.—This may be the result of improper allowance for expansion in one or other of the pipes or to excessive vibration. A careful examination of the pipe connections in the neighborhood should be made. Frequently a minor alteration of hangers, connections or the fitting of additional straps to eliminate vibration will prove effective.

Thickness of Pipe

Q.—Please give formulae for pipe thicknesses.

A.—The following formulæ are quoted from naval practice:

Let P=pressure above atmosphere in pounds per square inch.
D=inside diameter of pipe in inches.
D_1=outside diameter of pipe in inches.
T=thickness in inches (to be not less than 1/10 inch for steel pipe or $\frac{1}{8}$ inch for copper pipe.)

For straight copper pipe—

$$T = \frac{P \times D}{8{,}000}$$

For straight steel pipe—

$$T = \frac{P \times D}{10{,}000}, \text{ or,}$$

$$T = \frac{P \times D_1}{10{,}000 + 2P}$$

How to Detect Acid in Lubricating Oil

Q.—How may the presence of acid in lubricating oil be detected?

A.—(a) Dissolve as much phenol phthalein as can be put on a 10 cent piece in about 6 ounces of methylated spirit (10 parts by volume ethyl alcohol to 1 part methyl alcohol).

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(b) Add weak caustic soda solution by drops until the mixture takes on a faint reddish tint.

(c) Add a small amount of the oil to be tested and shake well.

(d) If there is any acid in the oil, the red color of the solution will disappear.

The above test is taken from naval instructions issued by the Bureau of Engineering, Navy Department.

Drinking Water

Q.—How would you make the water from an evaporator good for drinking purposes?

A.—By cooling, filtering and aerating the water.

Expansion Joints

Q.—For what purposes are expansion joints used on steam pipes and what other means are sometimes used for this purpose?

A.—An expansion joint is a stuffing box and gland fitted to various pipes to allow them to expand and contract without causing a fracture due to vibration of the vessel and different temperatures. Sometimes a suitable bend is used.

Location of Feed Heater

Q.—Which is the preferable location for a feed heater, on the suction side or delivery side of a feed pump?

A.—On the delivery side, as a pump cannot lift water that is too hot.

Broken Crank Shaft

Q.—If the low pressure crank shaft broke in a modern triple expansion engine, how could the ship be brought into port?

A.—Put in a spare crank shaft, if one is aboard; if not, shift the high pressure crank shaft, reduce the pressure and revolutions and run the engine compound.

Fire Apparatus Required

Q.—What fire apparatus is required aboard all ships whether passenger or freight?

A.—Steam fire pumps, hand pumps, portable fire extinguishers, fire hose, automatic fire alarm bells, axes and sand. Also smothering pipes to all holds, oil tanks and bunkers.

Coal Consumption

Q.—How many pounds of coal are burned per square foot of grate surface per hour in steaming natural draft?

A.—About 16 pounds per square foot of grate surface.

Rate of Evaporation in Scotch Boiler

Q.—About how many pounds of water are usually evaporated per pound of coal per hour in a Scotch boiler?

A.—About 8 pounds.

Horsepower of Engine

Q.—What elements are taken into consideration to figure the horsepower of a steam engine?

A.—The speed of the piston, the mean effective pressure of the steam in the cylinder and the area of the piston.

Lighting an Oil Burner

Q.—What precaution should be taken in lighting a burner when raising steam in a cold boiler?

A.—Circulate the oil until it is thoroughly heated. Have the burners clean. Never light more than one burner at a time and alternate the fires in different furnaces frequently so as to have equal distribution of heat.

Electric Wiring

Q.—What precaution should be taken in wiring portable lights and wiring in general?

A.—See that all wiring is so insulated as to prevent short circuiting.

Dynamo Operation

Q.—What are the points that require the most attention when operating a dynamo?

A.—Cleanliness of commutator brushes, fields and armature.

Will Water Extinguish an Oil Fire?

Q.—Should water ever be used in an attempt to extinguish an oil fire?

A.—Water should not be used for the above purpose except as a last resort. Then it should be used in large quantity and at high pressure. Except when so used the only effect will be to spread the flames over a larger area.

Result of Increased Vacuum in Turbine

Q.—Can you state quantitatively the gain in efficiency to be anticipated from raising the vacuum in a turbine installation?

A.—In a Manual of Engineering Instructions issued by the Navy Department is the following table which shows the progressive increase in efficiency due to an increase in vacuum. It is based on the available energy in the steam as given in the steam tables.

				Percent
Raising vacuum from 26	to 27	inches	increases efficiency about	4.3
Raising vacuum from 27	to 28	inches	increases efficiency about	5.3
Raising vacuum from 28	to 28½	inches	increases efficiency about	4.3
Raising vacuum from 28½	to 29	inches	increases efficiency about	4.3

Eliminating Water from Fuel Oil

Q.—What precautions should be taken to insure against the presence of water in fuel oil?

A.—All fuel oil tanks or bottoms to be used for fuel oil suction during the succeeding few hours should be sampled and tested. The results of these tests should be carefully recorded in the engine room log.

When oil is taken on board it should be allowed to settle, if practicable, preferably for as much as 72 hours. At the end of this time approximately 2 percent of the oil in the tanks recently filled should be transferred, using low suction, to an empty tank. This oil should be allowed to settle for another 72 hours. It should then be tested for the presence of water. If water is found, the oil should be purified by sending it through an oil separator.

Boiler Horsepower

Q.—What is meant by boiler horsepower and is the expression recognized by good marine practice today?

A.—The following is quoted from Marine Engineers' Handbook by Sterling: "In land practice, the term 'boiler horsepower' is accepted and specifically defined by engineering societies, so that the term loosely used in early days now signifies the definite amount of heat imparted to the steam in evaporating an equivalent of 34½ pounds of water per hour 'from and at 212 degrees F.' Marine engineers should avoid this archaic anomaly."

The term "horsepower" should not be used in connection with the boiler except in connection with the required steam output. Quoting from Sterling again, "The only proper measure of this (the required steam output) in English units is the number of pounds of water (avoirdupois) per hour which must be evaporated to produce the steam to operate the machinery, at the actual working pressure and from the actual feed temperature."

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Large Propeller Hubs

Q. (1,369).—Would there not be real advantages in using a larger propeller hub than is customary, particularly when the blades are detachable?

A. (1,369).—The following quoted from Taylor's "Speed and Power of Ships," page 169, appears to answer your question:

"One of the features of the Griffith screw introduced some fifty years ago was a large hub—sometimes with a diameter a third that of the propeller. These screws were often very successful, and as a result of practical experience there have for many years been advocates of large hubs. Experiments with model propellers at the United States Model Basin have shown that large hubs are distinctly prejudicial to efficiency.

"Full-scale experiments with turbine vessels seem to have shown the same thing, material gains in speed having been reported after substituting solid propellers with small hubs for propellers with large hubs and detachable blades. The argument against the large hub is very simple. When a large spherical hub is moving through the water there must be a strong stream line action abreast its center, the water flowing aft. Hence the inner portion of the blades must be working in a negative wake produced by the hub—a condition prejudicial to efficiency."

Regulations Covering Electrical Installations on Board Ship

Q. (1,372).—I would like to know what laws or regulations the installation of electrical equipment such as dynamos, motors, wiring, etc., on board American vessels come under, and where I may obtain a copy or copies of these regulations and what charge, if any, is made for them?

A. (1,372).—The General Rules and Regulations prescribed by the Board of Supervising Inspectors, Steamboat Inspection Service, Form 801 D, obtainable from the Department of Commerce, Washington, D. C., contains regulations relative to the protection of wires for lighting, their location, joints, etc., also requirements as to auxiliary systems for use in case of accident.

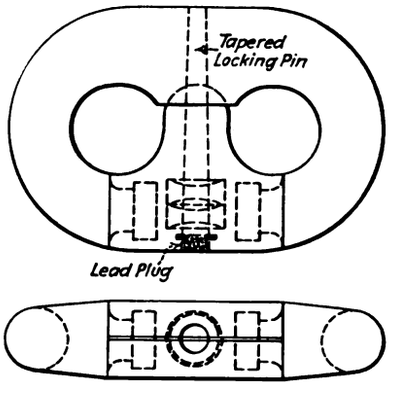
The recognized classification societies, The American Bureau of Shipping and Lloyd's Register of British and Foreign Shipping, in their Rules for Building and Classing of Vessels publish requirements covering plans to be submitted, tests, instructions relative to generating equipment, insulation, cable capacities, switchboard equipment, circuits, conductors, conduit, fixtures, fittings, temperature ratings and spare parts. The publications of these organizations may be obtained by ordering from 50 Broad Street, New York City, in the case of the American Bureau of Shipping, and 17 Battery Place, New York City, in the case of Lloyd's. I am unable to furnish costs.

In connection with this subject Sterling in the Marine Engineer's Handbook published by the McGraw-Hill Book Company, 239 West 39th street, New York city, devotes a chapter to Marine Electrical Installations. This chapter gives a good general discussion of rules and requirements; a sample of specifications for the electrical equipment of a freight vessel; comment relative to drafting and drawings; a discussion of the protection of conductors, lead covered and steel-armored conductor; generating sets with tabulated characteristics of turbine and reciprocating engine types; switchboard layouts and wiring diagrams and a general discussion of the lighting system, the power system and signaling system.

The Kenter Connecting Shackle

Q. (1,371).—In the December issue of MARINE ENGINEERING you have a sketch of a U. S. Navy Kenter connecting shackle which appears to be an improvement over the old type of shackle. I would appreciate any information you can give me as to its cost and as to the results obtained with it in actual service.

A. (1,371).—The Kenter type shackle as used in the Navy differs somewhat in shape and thickness from the original type as developed by the inventor, the Navy using special steel in its manufacture whereas the original invention contemplated ordinary mild steel. It results that the commercial type of Kenter shackle is larger than that used in the Navy and will only ride the wildcat in one plane.



Detachable link

In connection with the development of the Navy type shackle, there has been developed a so-called detachable link, intended to serve the same purpose, which is illustrated in the figure.

The following is a brief summary of the results of naval experience with Kenter shackles and detachable links during recent years:

There have been in service for a period of about four years a number of 1-inch detachable links. Reports received as to the general satisfactoriness of these detachable links are all favorable. About a year ago a number of Kenter shackles and detachable links were furnished for comparison in service. The shots in the ships' cables were assembled using alternately a Kenter shackle and a detach-

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able link. The detachable links and Kenter shackles were issued for this purpose with the view of determining the comparative merits of Kenter shackles and detachable links of larger size in service. Such reports as have been received from the vessels have been favorable to the detachable link. The following is based on reports received from vessels testing detachable links in service, and comparative shop tests of both types of shackles:

Strength: Kenter shackles have a slightly greater tensile strength than detachable links. The transverse strength of detachable links is somewhat greater than that of Kenter connecting shackles. However, both types have considerable tensile and transverse strength in excess of the chain of corresponding size with which they are used. The assembling and disassembling of Kenter connecting shackles can be easily accomplished even though deformation of the shackles as a result of stresses in excess of their elastic limit may be imposed in service. This is not true of the detachable link, which becomes inoperative as far as its further use is concerned, upon elongation. However, the elastic limit of both types of shackles is sufficiently great to preclude the possibility of deformation under all normal operating conditions of service.

Cost: The initial cost of dies for either type of shackle is about the same. The interlocking sections of the Kenter connecting shackles are drop forged and machined. The detachable link is practically an all-forged process, there being very little, if any, machining required. The unit cost of manufacturing detachable links is approximately one-half that of Kenter shackles. The maintenance cost of the dies for the detachable links, however, will probably exceed considerably the cost of the dies for the Kenter shackles. This opinion is based on the fact that the dimensions and finish of the interlocking parts of the detachable link have to be almost as smoothly finished as the machined interlocking parts of the Kenter connecting shackles. In order to do this it will probably be necessary to frequently resink the detachable link dies. However, it is believed that the ultimate unit cost of detachable links including the pro-rated costs of the dies will be considerably less than the cost of Kenter shackles.

Adaptability: It is more difficult to assemble large cables with Kenter shackles than with detachable links in view of the fact that the interlocking halves of the Kenter shackles have to be in perfect lateral alinement in order to connect them up. The detachable link is more readily assembled in the cables as the only operation required is to thread the end links of each shot into the C shaped links and insert the coupling plates and pin in place. However, the Kenter shackle can be more expeditiously disassembled as it is not required that the strain be removed from the cable as is necessary when the detachable link is used.

If the locking pin of the Kenter shackles is accidentally displaced, the shackle will probably completely disassemble upon application of a side stress. Under such conditions the anchor and chain are likely to be lost. The detachable link, due to being C-shaped, will continue to function as a connecting link for the shots of chain as long as there is a strain on the cable, even though the pin and coupling plates become broken or lost. It appears that the detachable link has an advantage over the Kenter shackle from the standpoint of cost. In the sizes which have been tested to date it appears that as far as facility in assembling and disassembling anchor cables is concerned, the detachable link has considerable advantage over the Kenter shackle.

Note: The Kenter shackle as referred to above is the U. S. Navy type, not the Kenter type commercially available.

Discontinuance of Fire Proofing of Wood in Shipbuilding

Q.—Some years ago wood used in the construction of naval vessels was subjected to certain fire proofing processes. I think that this is no longer done. What were the reasons for its discontinuance?

A.—Fire proofing in the U. S. Navy has been discontinued for somewhat over twenty years. Experience with fireproofed material in service was responsible for its discontinuance for various reasons, among which were the following:

(a) Greater first cost of the material.
(b) Added expense in working, due to the injurious effect of the salts in the wood upon the wood working tools.
(c) Increased cost of repairs and maintenance, due to the injurious effect of the contained salts upon the paint used for purposes of protection; and the rapid deterioration of metal fittings in contact with the treated wood due to corrosion, because of the contained salts.
(d) The reduction of the fire resisting qualities of the wood with the lapse of time. This effect was very marked in the case of weather decks.
(e) The more satisfactory results obtained by the substitution of metal for treated wood in the construction of bulkheads, lockers, shelves, etc., in all spaces where the risk from fire in action is comparatively great.

LETTERS TO THE EDITORS

The Motorship Dolius

LONDON, Eng.

TO THE EDITORS:

I was very much interested in the article in your issue of December, 1926, on the M.S. *Dolius.*

I judge from this, and also from letters received by me from old friends on your side of the water, that the ship and her machinery appear to have created quite a good impression. Some additional information, which might not have been available at the time of your inspection, would no doubt be of interest and might draw attention to the outstanding merits of an engine which has not, for various reasons, been as widely advertised as some other types have been.

The fuel consumption is probably the lowest per brake horsepower recorded up to date, and in this connection a paper read by Mr. S. B. Freeman, superintendent engineer for Messrs. Alfred Holt & Company, the owners of the *Dolius,* before the North East Coast Institution of Engineers and Shipbuilders, in December, 1924, gives a very useful method of comparing the oil consumption in similar ships by means of an "oil coefficient."

$$\text{This "oil coefficient" } C = \frac{D^{2/3} \times K^3}{T} \text{ where}$$

D = the actual displacement of the ship in tons,
K = the average speed of the period in knots.
T = the fuel consumed for all purposes in tons per day.

At that time Mr. Freeman had compared the records of some 80 vessels and had arrived at the following average results:

	Degrees, F.	Pounds Per Shaft Horsepower	C.
Reciprocating engines, coal fired boilers, saturated steam	.....	1.65	16,000
Reciprocating engines, coal fired boilers, superheated steam	160-200	1.5	18,500
Turbine engines, coal fired boilers, superheated steam	160-200	1.425	19,500
Turbine engines, oil fired boilers, superheated steam	160-200	0.90	30,000
Oil engines, four stroke single acting	.....	0.41	64,000
Oil engines, two stroke Still engine (one voyage)	.....	....	76,000

The figure 76,000 for the Still engine is that obtained by the *Dolius* on her very first voyage, which was closely watched by the engine builders. The ship was on her fifth long voyage when she called at New York; she had covered 16,700 knots on that voyage, and her oil coefficient was over 78,000. The owners have no objection to letting it be known that the machinery is running very well, maneuvers exceptionally quickly, and is using less fuel oil than any of the other types of oil engine of which they have knowledge. Seeing that Messrs. Alfred Holt have

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fitted a large number of the best known Diesel engines of different types in their ships, this statement is very illuminating. Their latest ship is one larger than the *Dolius*, fitted with Scott-Still engines of twice the power.

You will no doubt have noted that the *Dolius* is very heavy on electrical equipment, having three Diesel driven generators each of 100 kilowatts for electric heating, cooking, winches, windlass, etc. In spite of this, her oil coefficient is more than 78,000, and her actual consumption for all purposes is about 8.5 tons per day, her average displacement being about 10,000 tons, and average speed 11.3 knots.

Little attention has been given to what is probably the most valuable feature in this engine. Compressed air is not used. Starting and maneuvering are done by steam, which for starting from cold is generated by independent firing of the boiler or boilers. After the engine has run for a short time this independent firing can be shut off because the necessary steam is then generated by the heat of the exhaust gases. In the *Dolius* or any twin screw ship with Still engines there are eight methods of obtaining power for propulsion.

1. Steam on one engine,
2. Steam on two engines,
3. Oil on one engine,
4. Oil on two engines,
5. Oil and steam on one engine,
6. Oil and steam on two engines,
7. Oil on one engine and steam on the other,
8. The reverse of No. 7.

Any other oil engined twin screw boat has only two chances and, if anything goes wrong with the air compressing plant, she has no chance whatever.

The presence of steam makes it possible to navigate a boat with still machinery in confined waters with absolute safety. There is no chance of being driven on to a lee shore in the event of the oil part of the machinery breaking down. Steam is available.

The power of the Still machinery is not limited to the power derived from the oil side alone, as is the case with all other similar engines. About 10 percent of its power is derived from steam, and by lighting up in the boiler or boilers, additional power, to the extent of another 10 percent or 15 percent can be generated and can be made use of for propulsion, thus giving increased speed and making it possible, as has already been done, to make up time unavoidably lost.

The engine is relatively small in height. There are no overhead valves, cams, rockers, etc., to be looked out for. There is only one valve in each cylinder head and it is operated by pressure. As compared with another oil engine developing the same total brake horsepower the Still engine is smaller to the extent of the normal power derived from the steam side, consequently a smaller machinery space is required. The fact that the engine is relatively low makes it possible to install this type of machinery in such vessels as yachts where space is limited. Here the steam can be used for heating and cooking, and the electrical equipment can be kept down to the minimum.

The engine is the most suitable for installation in such vessels as trawlers and tugs, as steam operated deck machinery and auxiliaries to which the crews are accustomed can still be used and, by using the steam side of the machinery, the pull on a trawl rope and on a tow rope can be taken up very gently, even more gently than in the case of a similar boat fitted with the ordinary steam engine, the reason being that the Still engined boat, at full power, does more revolutions per minute than the steam engined boat, the propeller is therefore smaller, the engine can run under steam just as few revolutions a minute in the one boat as in the other and consequently, due to the smaller propeller, the speed can be less, and the pull on the rope more gradual.

A feature of the Still engine which is not visible from the outside is the construction of the cylinder liner. This is very thin and, is ribbed and strengthened by a steel band in the region of the greatest pressure. This thin liner allows for very rapid transference of heat to the surrounding water jacket. It is patented and has lately been adopted by several first class makers of other types of Diesel engines.

One point which has been raised is the possibility of oil getting past the piston rings into the steam side and so into the boiler. This was not overlooked by the designers; it did happen but was cured in a very short space of time. I saw the boilers of the *Dolius* immediately after they were opened up on the ship's arrival home after one of her long voyages, and I can truthfully say that I never saw cleaner tubes, even in an unused boiler.

Engines on the same principle as the Scott-Still engines fitted in the *Dolius*, but of smaller power, are made by Messrs. Plenty & Son, Ltd., of Newbury, England, and are particularly applicable to vessels such as coasters, trawlers, tugs, yachts, etc. In one of these types, the cylinders are each 150 brake horsepower and in the other of 60 brake horsepower. By varying the number of cylinders in each type of engine, there is a wide choice of means for obtaining a particular amount of power. The overall consumption of each of these types is less than 0.4 pound of oil per brake horsepower. The engine is known as the Plenty-Still and the cost, in England, of the complete engine, shafting, propeller, boiler, condenser, skin fittings, bilge and ballast boxes and the auxiliaries, steam driven, for use in connection with the engine itself, such as feed pump, condenser circulating pump, etc., does not exceed in Britain, about $54 per brake horsepower. To this must be added the cost of installation, and the cost of other auxiliaries such as ballast pump, general service pump, etc. The total cost installed is not much greater than the cost of a steam installation developing the same shaft horsepower. Messrs. Plenty & Son, Ltd., make this type of engine, but non-reversible, for stationary work also. The weight of this type of engine is low. A twin screw set consisting of two engines, shafting, propellers, boiler, condenser, the necessary auxiliaries, including the scavenge blower, will not exceed 150 long tons for 1,800 brake horsepower or 187 pounds per brake horsepower. The cost would be about £20,000 delivered ready for installation, i.e., £11.12.0. ($54) per brake horsepower or 28½ cents per pound.

Another variety is made for land work by Messrs. Peter Brotherhood, Ltd., of Peterborough, England. This is of the opposed piston type, and develops 185 brake horsepower per cylinder at 300 revolutions per minute with a fuel consumption of 0.37 pound per hour.

In all these types of machines there is a noticeable absence of vibration, a feature which is of surprising monetary value in the case of a trawler, and should be highly appreciated in all other cases. This is due to the comparatively small height, to the very stiff framing and to the effect of the steam side of the engine. J. A. Sim.

Correction.—In the abstract of the paper read before the Society of Naval Architects and Marine Engineers by Lieutenant W. P. Roop, C.C., U. S. N., on "The Strength of Propeller Shaft Struts" which was published on page 719 of our December, 1926, issue several typographical errors occurred in printing the formula for strut area. This formula should read:

$$a = \frac{P}{2 \sin \theta} \times \frac{1 + \frac{3b}{2l}\left(1 + \frac{R}{l}\right) \frac{\cos \theta}{\sin \theta - 3b/2l}}{\text{Stress in strut}}$$

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PERSONAL MENTION

AXEL F. NILSSON has been promoted to second assistant on the *Maunalei* of the Matson fleet.

G. M. GUSTAVSON, formerly first assistant engineer of the S.S. *Algic* of the Roosevelt Line, is now chief engineer of the *Algic*.

J. L. LOUNSBERRY has been appointed Philadelphia district manager of the Dollar Line, succeeding W. H. Diehl, resigned.

CHARLES MORTON, formerly first assistant of the *Venezuela*, has been appointed first assistant of the Panama Mail liner *Ecuador*.

H. CLAUSON, formerly chief engineer of the *Algic* of the Roosevelt Line, is first assistant engineer of the *Argosy* operated by Moore & McCormack.

CHARLES B. MILLER has severed his connection with the *Maritime Register* after 28 years of service and joined the staff of *Pigott's Bulletin*, New York.

CARL B. WERNER, formerly first assistant on the motorship *Seekonk*, is now second assistant engineer of the Shipping Board motorship *Crown City*.

F. H. JENSEN was promoted to third assistant on the Matson steamship *Mana* having previously served as licensed junior on the *Maui* of the Matson fleet.

A. E. MIELSEN, formerly first assistant of the Matson steamship *Makiki*, has been appointed chief engineer of that vessel and R. H. Sample has been appointed first assistant.

WM. J. MOGNEY, formerly one of the engineering staff of the *Ernest H. Meyer* of Portland, Ore., has been appointed first assistant of the *Sea Foam* of San Francisco, Calif.

R. G. RAMSAY, formerly first assistant on the *Humboldt* of the J. K. Nelson fleet, San Francisco, Calif., has been promoted to chief engineer of the *San Juan* replacing Peter Norton, retired.

H. E. GILPIN, president of the Great Lakes Towing Company, is recuperating in Miami, Fla., from a serious operation which he underwent in a Cleveland hospital several months ago.

JAS. E. AHEARN, who has for several years been serving in various capacities on several ships of the Matson fleet, was promoted to first assistant of the *Wilhelmina* on her recent arrival in San Francisco.

Chief engineers for the vessels of the Franklin Steamship Company, Cleveland, O., for the 1927 season are: Steamer *F. G. Hartwell*, A. H. Amhaus; *E. J. Berwind*, Thomas Griffiths; *E. L. Ford*, S. Ramberg.

RICHARD A. DOMINGUEZ has been promoted to second assistant engineer of the *Jane Christenson* of San Francisco, replacing John I. Clark, resigned. Louis Strom has joined the ship as third assistant engineer.

J. T. WELSH has been appointed chief of the technical section of the maintenance and repair division of the Merchant Fleet Corporation, New York, succeeding H. E. Brelsford who recently resigned.

RICHARD P. STEVENS, first assistant of the *Daisy Freeman* owned by the Charles Nelson Company, Inc., San Francisco, Calif., has been appointed first assistant of the *Grays Harbor* operated by Sudden and Christenson of San Francisco.

HERMAN LA BRANCE has joined the *Stockton*, one of the Struthers & Barry tankers, as third assistant. For several years past Mr. La Brance has been employed in various capacities in the Matson fleet.

ANDREW J. MURPHY has been appointed second assistant on the *Rose City*, of the Rose City Steamship Company, Portland, Ore., relieving Clarence H. Poor who has been serving in that position for several years.

D. Sullivan and Company, Chicago, Ill., has appointed the following chief engineers for its vessels for the coming season: Steamer *Wolf*, R. Elhamer; steamer *Otto Reiss*, John Thomas; steamer *Fitzgerald*, James Linton.

WILLIAM P. FEELEY, at one time in charge of the Cleveland office of the engineering division of the Great Lakes Dredge & Dock Company, has been appointed manager for the company's Buffalo office, succeeding F. C. Hubbard.

CAPTAIN T. HOWARD SAUNDERS, commander of the steamship *M. A. Bradley*, has been appointed president of Buffalo lodge of the International Shipmasters' Association. Captain William MacDonald was appointed first vice president.

MAJOR H. M. TRIPPE, United States Engineer in charge of the Huntington (W. Va.) district of the Ohio river, will be transferred to the Panama Canal zone and will leave for that post about July 1. His successor has not as yet been appointed.

D. J. CODY, formerly chief engineer of the steamship *Eastern Dawn* of the Black Diamond Steamship Corporation, has been made chief engineer of the recently converted Shipping Board motorship *Crown City*, operated by the Roosevelt Line.

The Morrow Steamship Company, Cleveland, O., has appointed the following chief engineers: Steamer *A. E. R. Schneider*, A. A. Smedley; steamer *Thomas Britt*, A. Multiner; steamer *J. Anderson*, Joseph Grant; steamer *D. E. Callender*, F. W. Hunt.

A. K. JOHNSON has been appointed first assistant engineer of the Dollar liner *President Wilson*. H. P. Hansen is senior second, T. T. Overton, junior second, and G. Barker, third. The three juniors are W. J. Carroll, W. F. Maguier and Chas. Seaton.

C. T. MCFEELY has been appointed to serve as one of the senior assistants on the new Matson liner *Malolo*, now under construction at Cramps shipyard, Philadelphia, Pa. Mr. McFeely was formerly chief engineer of the S. S. *Makiki* of the Matson Line.

G. W. CHRISTIANSON has been appointed first assistant of the *Condor*, formerly the *Rotarian*, of the Grace Steamship Company to succeed Dave Doig. Oliver A. Woodworth was promoted to the position of second assistant and Harry Boyd joined the ship as third.

JOHN TIPPEN, chief engineer of the *Everett* when the vessel was destroyed by fire last year, has been appointed chief of another of the McCormick Lumber Company ships, the *Wahkeena*. N. O. Johnson and E. M. Puntney are serving with him as first and second assistants.

The Valley Camp Steamship Company, Cleveland, O., has appointed the following chief engineers for its vessels for the coming season: Steamer *E. G. Mathiott*, C. Wolvin; steamer *H. T. Ewig*, H. Multiner; steamer *J. M. Kennedy*, Ed. Jacques; steamer *S. B. Way*, William Radke.

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OTTO PUSHMAN, chief engineer of the Shipping Board steamer *Montague* has been transferred to the position of chief engineer of the *West Prospect.* T. W. Smith, Jr., was promoted to first assistant of the *West Prospect;* S. McLeod is second and Fred Krick joined the ship as third.

OSCAR ERIKSON who for a number of years served in the engine room staff in the U. S. Navy and more recently was first assistant engineer of the steamship *Winston-Salem* operated in Gulf services by Lykes Brothers, has been made first assistant engineer on the Shipping Board motorship *Crown City.*

WM. J. BLAKE has been appointed port engineer for the Charles Nelson Company, San Francisco, Calif. This position was held for a considerable time by Robert N. Miller who resigned to take up the duties as representative port engineer for Swayne & Hoyt, Inc., in New Orleans and other gulf ports.

The Rutland-Lake Michigan Transit Company, Chicago, Ill., announces the following appointments as chief engineers in its fleet: Steamer *Burlington,* William Walder; steamer *Brocton,* F. J. Harmon; steamer *Brandon,* Joseph Murphy; steamer *Bennington,* Thomas Weisiger; steamer *Back Bay,* G. McCullough.

The Interstate Steamship Company, Cleveland, O., will make no important shifts in its engine room personnel this year, the line up of chief engineers for the four vessels being: Steamer *B. F. Jones,* Crosby Irish; *James Laughlin,* Edward Reilly; *W. L. King,* W. H. Ballard; *Thomas Walters,* William Sicken.

The Kinsman Transit Company, Cleveland, O., has appointed the following as chief engineers of the vessels of its fleet for the coming season: Steamer *George M. Humphrey,* W. H. Miller; steamer *W. Clarkson,* J. Berquist; steamer *Max Andrews,* J. G. Reyer; steamer *Philip Minch,* W. S. Fandred; steamer *H. Steinbrennen,* W. S. Tweedale.

REAR ADMIRAL WILLIAM R. SHOEMAKER, chief of the Bureau of Navigation, has retired from office upon reaching the statutory limit of 64 years. Rear Admiral Richard H. Leigh has taken the oath of office as his successor. Admiral Leigh has been assigned as chief of staff to Admiral Charles S. Hughes, commander-in-chief of the United States fleet. He has previously served on two occasions as assistant chief of the Bureau of Navigation.

The line up of chief engineers in the fleet of the Reiss Steamship Company, Sheboygan, Wis., for the 1927 season is as follows: Steamer *W. K. Field,* Alex McLaren; *Peter Reiss,* J. Richardson; *J. P. Reiss,* J. J. Maloney; *A. M. Byers,* J. E. McNeill; *J. L. Reiss,* H. P. Nelson; *R. J. Reiss,* L. F. Miller; *W. A. Reiss,* H. J. Rake; *C. A. Reiss,* Frank Duffy; *Alex B. Urig,* M. R. Rake; and for the Rockport Steamship Company (a Reiss unit): Steamer *C. C. West,* M. G. Cook; *J. A. Kling,* E. Pickering.

EDGAR F. LUCKENBACK, president of the Luckenbach Steamship Company, New York, was appointed chairman of the executive committee of the American Steamship Owners' Association at the annual meeting of the association held at New York on Monday, February 7. Paul H. Harwood, vice president of the American Petroleum & Transport Company, was elected vice chairman and R. J. Baker was elected to fill the newly created office of treasurer with the title of secretary-treasurer. Ira A. Campbell was re-elected as general counsel. Although the three-year term of Alfred Gilbert Smith as president of the association has expired, no action was taken to fill the vacancy. It is understood that the office will be left open for two or three weeks pending the reorganization of the several committees. Mr. Smith has been reluctant to continue as active head of the organization on account of the state of his health.

Chief engineers in the fleet controlled by the M. A. Hanna Company, Cleveland, O., for this season are announced as follows:

The Calumet Transportation Company vessels: W. R. Stewart for the steamer *R. L. Agassiz;* R. M. Akerley for the *E. N. Saunders, Jr.;* P. J. Ahorn for the *Q. A. Shaw;* John Wait for the *J. J. Turner;* S. F. Atkinson for the *E. A. Uhrig.*

The Producers Steamship Company: A. Farquhar for the steamer *W. A. Amburg;* A. Robertson for the *L. W. Hill;* J. A. McCarron for the *C. Thompson.*

The Mahoning Steamship Company: H. F. Stearns for the steamer *D. H. Donner;* W. J. Baird for the *P. Stackhouse;* F. L. Saunders for the *L. C. Hanna.*

The Virginia Steamship Company: J. Summerville for the steamer *W. D. Crawford.*

The Eastern Steamship Company: A. F. Autterson for the steamer *Joseph Wood.*

The LaBelle Steamship Company: R. H. Shinskey for the steamer *LaBelle.*

The Donner Steamship Company: E. W. Frye for the steamer *H. F. Black.*

OBITUARY

WILLIAM MILLINGTON, for many years chief engineer of steamers operated by Cornelius and Boland, of Buffalo, died in Erie, Pa., on January 23.

JOHN P. L. KLANSEN, aged 63, who was chief engineer of the Great Lakes freighter *John B. Powell* when she was caught in an ice jam last fall, died at his home in Cleveland, on February 18. He was born in Port Huron and served on the lakes for 40 years.

CAPTAIN THORMOD JULLUM, general agent in the United States and Canada for several Norwegian and Swedish marine insurance companies, died of pneumonia on Friday, January 28, at the Long Island College Hospital, Brooklyn, N. Y. Captain Jullum was 56 years of age.

BENJAMIN NIKOLAS BROIDO, chief engineer of the Industrial Department of The Superheater Company of New York and Chicago, died suddenly at his home in New York on February 10, 1927. Mr. Broido was known throughout this country and abroad as a designer of exceptional ability of steam superheaters and heat exchange apparatus. He was 48 years of age.

BENJ. CARPENTER, president of the George B. Carpenter and Company, Chicago ship chandlers, and vice president of the Anniston Cordage Company, of Anniston, Ala., died in Chicago, February 22. He was 61 and a brother of federal judge George A. Carpenter. The deceased was also a director of the Commonwealth Edison Company and of the Illinois Merchants' Trust Company, in Chicago.

GEORGE L. QUAYLE, aged 85, pioneer shipbuilder of Cleveland, and for half a century widely known on the Great Lakes, died in a Jacksonville, Fla., hospital on February 22. His father, Thomas Quayle, was a shipbuilder, and the son, George, and two brothers, Thomas and William, began making speedy wooden vessels for the Great Lakes long before the Civil War. When the elder Quayle died George became the head of the firm. He was a veteran of the Civil War and took an active part in the civic and business life of Cleveland for many years after the Civil War, being connected with the Cleveland Savings and Loan Company and other similar institutions.

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The Month's Shipping and Shipbuilding News in Brief

Shipyard, Steamship and Port Activities and Other Notes of Interest in All Branches of the Marine Industries

Specifications Nearing Completion for Construction of New York City Ferryboat

INFORMATION has been received that plans and specifications have been prepared by the Department of Plant and Structures, New York City, for the construction of a ferryboat which is to be a sister vessel of the *American Legion*, acceptance trials for which were held last month. These plans have been prepared by R. W. Morrell, naval architect for the Department of Plant and Structures, of which A. Goldman is commissioner. It is understood that slight changes are to be made in the design and equipment but that the new ferryboat will be similar to the *American Legion* in all essential details. The matter is now under discussion by the Board of Estimate and as soon as authorized, the specifications will be issued to prospective bidders. It is understood that the authorization will be given in the near future and the plans issued some time this month.

The general details of the ferryboat will be: Length overall 264 feet; breadth over guards 66 feet; depth of hull at guard 19 feet, 4 inches; draft in operating condition, 12 feet, 6 inches. The lower hull will be entirely of steel, while the deckhouses will be of wooden construction.

So far as is known, very few changes will be made in the propelling machinery from that installed on the *American Legion*, which is equipped with two vertical compound steam engines coupled together and driving a cast steel propeller at each end. The engine cylinders in this boat are 22½ inches and 50 inches diameter, with a 30-inch stroke, designed for about 4,000 indicated horsepower. Steam is furnished by four watertube boilers having a heating surface of about 3,575 square feet each and a working pressure of 225 pounds per square inch. These boilers are also equipped with mechanical oil-burning systems. The usual pump and generator equipment for auxiliary machinery is installed in the *American Legion* and the new boat will follow the same general lines in this respect. Further details will be available shortly.

California Petroleum Co. Orders Tanker from Sun Yard

IT is understood that the California Petroleum Corporation, Los Angeles, California, has placed an order with the Sun Shipbuilding and Drydock Company, Chester, Pa., for the construction of a 13,000-ton bulk oil carrier. This vessel makes the third for which the Sun shipyard has taken orders, the other two being built for the Sun Oil Company, New York, reports of which have appeared recently in this journal. The three vessels will cost approximately $5,000,000.

House Authorizes Construction of Three Scout Cruisers

IMMEDIATE construction of three cruisers was ordered by the House of Representatives on Thursday, Feb. 24, by a vote of 208 to 172. In yielding the House compromised by cutting the Senate appropriation for the cruisers from $1,200,000 to $450,000. No date has as yet been set as to when construction will start and no money has been appropriated for plans.

Tide Water Oil Company Orders Tanker

IT has been learned unofficially that the Tide Water Oil Company, 11 Broadway, New York City, is about to purchase a tanker from the Sun Shipbuilding and Drydock Company, Chester, Pa. It could not be learned, at the time of going to press, whether the Tide Water Oil Company was placing a contract with the Sun yard for a new tanker or if negotiations involved the purchase of the tanker which was recently laid down at the yard for stock. It is believed that this vessel will be of about 13,000 tons deadweight capacity and will be propelled by reciprocating engines.

Contracts Awarded for Reconditioning of S.S. President Harding

BIDS covering annual overhaul and oil tank work on the steamship *President Harding* were opened last month at the office of the marine superintendent of the United States Lines, Pier 4, Hoboken, New Jersey.

A contract for boiler cleaning was awarded to the Union Ship Scaling and Painting Company, Hoboken, New Jersey, at a price of $7,200.

Contract for drydocking awarded to the Morse Drydock and Repair Company, Brooklyn, New York, at a price of $35,641.

Tank cleaning contract awarded to Joseph F. Power, New York, at $1,085.

Main contract, including general overhaul, repairs to double bottom, fuel tanks and the like, was awarded to the Robins Drydock and Repair Company, Erie Basin, Brooklyn, New York, at a price of $24,910.

Contract for boiler brickwork was awarded to the Mack Engineering and Supply Company, New York, at a price of $11,576.

Pipe installation and covering contract awarded to the P. S. Thorsen Company, New York, at a price of $4,897.

In addition to these, a number of smaller contracts, including interior painting, galley repairs and the like, were awarded, which will bring the total to a somewhat higher figure.

Standard Transportation Co. Asks Alternative Bids for Construction of 3 Tankers

BIDS were received by the Standard Transportation Company, New York, on Wednesday, February 23, covering specifications for the construction of one, two and three twin screw Diesel tankers. These bids were received at the office of the naval architect of the company, but were not publicly opened.

It is understood that requests have been sent to each of the bidders to submit alternative proposals for one, two or three ships having the same details, but equipped with turbine machinery and also with reciprocating engine machinery. The closing date for these alternative bids is set for March 1. The shipyards receiving a request for alternative proposals include: Sun Shipbuilding and Drydock Company, Chester, Pa.; American Brown Boveri Electric Corporation, Camden, N. J.; William Cramp and Sons Ship and Engine Bnilding Company, Philadelphia, Pa.; Newport News Shipbuilding and Drydock Company, Newport News, Va.; Federal Shipbuilding Company, Kearny, N. J., and the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa.

The tankers will have a length of 489 feet; beam of 62 feet, 6 inches and a loaded depth of 29 feet, 3 inches. Carrying capacity will be approximately 13,400 deadweight tons.

Gulf Refining Company Places Orders for Six Tankers Abroad

THE Gulf Refining Company of Pittsburgh, Pa., recently placed contracts with British shipbuilders for the construction of six oil-carrying vessels of an aggregate value of £1,000,000. The first three will be built by Furness, Withy and Company and the other three will be built at Jarrow for the Venezuela business of the Gulf Company. Three tankers will be of 15,000 tons deadweight and constructed on the Isherwood bracketless system and Dieselized. The other three will be twin-screw oil tankers of 3,700 deadweight tons.

Cities Service Co. About to Order One or Two Tankers

INFORMATION has been received that the Cities Service Company, New York, is about to place a contract for the construction of a 13,000-deadweight ton tanker. It is understood that the matter will be settled within a few days and that authority for two tankers may be given instead of one. Specific details are not available as yet, but will undoubtedly be forthcoming within a few days.

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Canadian Merchant Marine to Build Five Liners—Three to Be Constructed in Canadian Yards

PLANS are now being prepared by the Canadian Government Merchant Marine for the construction of five new liners to meet the requirements of the special services between the Dominion and the West Indies provided for in the trade treaty entered into some time ago, and tenders will be called for immediately. Three vessels, it is understood, will be built in Canadian yards, while two will be constructed in the United Kingdom. These vessels will not be ready for service until some time next year.

The new ships will be of 5,000 or 6,000 gross tons each and will be capable of maintaining a speed of 14 knots. Until a few days ago, it was believed that the Canadian Government Merchant Marine would purchase the vessels instead of constructing new ones.

Bethlehem Fore River Yard to Convert S.S. Berkshire to Collier

THE Bethlehem Shipbuilding Corporation, Ltd., has been awarded a contract for the conversion of the cargo ship *Berkshire* into a collier at the Fore River plant of the company, Quincy, Mass. This vessel was recently bought by the Coastwise Transportation Company, Boston, Mass., from the United States Shipping Board. The former name of this vessel was the *Eastern Tempest*.

The *Berkshire* was built in 1920 by the Urago Dock Company, Ltd., Japan. She has a length of 361.1 feet, a beam of 51.2 feet and a molded depth of 28 feet 6 inches. The vessel has a carrying capacity of 6,650 deadweight tons. Steam is supplied by two Scotch boilers at 185 pounds per square inch pressure to a 3-cylinder triple expansion engine developing 2,650 indicated horsepower.

Barge Contract

A CONTRACT has been awarded to the Hanlon Drydock and Shipbuilding Company, foot of Fifth avenue, Oakland, California, by the Union Oil Company, Los Angeles, for the construction of a barge to be used in the transportation of hot asphalt. The barge will be the first of its kind on the Pacific Coast and will be equipped with large circular tanks. She will be 100 feet long, 40 feet beam and 9 feet deep. The price involved was not made public.

Contract for Diesel Engines Awarded to Worthington Co.

A CONTRACT for the construction of three auxiliary Diesel engines has been awarded to the Worthington Pump and Machinery Corporation, 115 Broadway, New York, by the United States Shipping Board, to be used on the converted motorships. This makes the fourth contract placed with the Worthington Corporation and brings the total of Diesel engines ordered since December, 1924, up to 21. The engines are of the two-cycle solid injection type and are used for operating the engine room and deck machinery and for lighting purposes.

Gulf Refining Company May Build Tanker

IT is reported that the Pittsburgh office of the Gulf Refining Company is considering the construction of a 13,000-ton tanker which will be a duplicate of the *Gulfpride*, now under construction at the Federal Shipbuilding Company's yards, Kearney, New Jersey. The latter vessel has a length of 525 feet. It has so far been impossible to confirm this report at the New York Office of the Gulf Company.

Jones and Laughlin Steel Corp. to Build Barges

THE Jones and Laughlin Steel Corporation will shortly begin construction of the first railroad carferry in the Pittsburgh district.

Details have also been completed for the construction of two steel barges which are to be used between the Pittsburgh and Woodlawn, Pa., plants of the Jones and Laughlin Corporation, one barge to be at the disposal of each terminal. The barges will be 200 feet long, 35 feet wide and have a capacity of eight railroad cars of 100 tons each.

Eastern Steamship Liner Evangeline Launched at Cramps

THE steamship *Evangeline* of the Eastern Steamship Lines, Inc., Boston, Mass., was launched at the yards of the William Cramp and Sons Ship and Engine Building Company, Philadelphia, Pa., on February 12, with Miss Betty Dumaine as sponsor. Upon completion, the *Evangeline* will inaugurate a new passenger steamship service out of New York to Yarmouth.

The *Evangeline*, like the *Yarmouth*, her sister ship previously launched at Cramps, is of 5,880 tons displacement. She is a twin screw, turbine driven, oil-fired liner with a length of 378 feet; a breadth of 55 feet, and a depth 29 feet.

Standard Oil of California Orders Four 1,000 Horsepower Busch-Sulzer Diesel Engines

THE Busch-Sulzer Brothers, Diesel Engine Company, St. Louis, Missouri, has been awarded a contract for the construction of four 1,000-horsepower engines by the Standard Oil Company of California, for installation in the tanker *District of Columbia*, which is being converted to Diesel-electric drive. These engines will have eight working cylinders and run at 275 revolutions per minute. They are of the new trunk piston, two-cycle design, and are rated at 1,100 brake horsepower for a continuous 5-day period. The price involved was not made public.

Self Propelled Barges

TENDERS for the construction of a number of self-propelled canal barges are reported to be in prospect in marine circles. The name of the company contemplating these barges has not as yet been learned, although it is expected that this information will shortly be available.

Ferryboat American Legion Has Successful Trials

THE *American Legion*, the largest and best of the fleet of New York City ferryboats, had a successful four-hour trip up the Hudson river on Tuesday, February 22. While the new ferryboat is similar to the *President Roosevelt*, the last to be commissioned in the Staten Island service, many improvements have been incorporated in the latest model. The *American Legion* is 264 feet long and has a speed of 18½ miles an hour. The lower hull is entirely of steel and the hull and machinery were built under a special survey of the American Bureau of Shipping.

STEEL SPONSONS ADOPTED

One of the principal improvements is the adoption of steel sponsons in the hull in place of guard braces, thus increasing stability and avoiding damage to guard braces which has been experienced in previous designs.

Hudson River Day Line Steamer Launched at Pusey and Jones Yard

THE new Hudson River Day Line steamer *Peter Stuyvesant* was launched at the shipyards of Pusey and Jones, Wilmington, Del., on Wednesday, February 2. The vessel is 268 feet long, with a beam of 60 feet and will draw 12½ feet. She will have a hull and main deck of steel with three joiner decks above. The *Peter Stuyvesant* will be equipped with four Babcock and Wilcox watertube boilers, fitted with oil burners of the Peabody type and arranged for forced draft.

The main engine will be a four-cylinder triple expansion surface condensing engine balanced on the Yarrow-Schlick-Tweedy system and designed to develop 2,800 horsepower at 125 revolutions a minute. The Day Line will resume its daylight trips on the Hudson on May 20.

Contrapropeller Patents Upheld in German Courts

THE suit which Dr. Oertz, inventor of the Oertz rudder, had instigated against the Star Contra-propeller patents in an effort to declare said patents invalid, was settled, by the German Government Patent Court in Berlin in November 1926 in Star Contrapropeller, Ltd. A/S favor, Dr. Oertz being charged with the expenses.

The suit which Star Contrapropeller, Ltd. A/S have started against Dr. Oertz for infringement is at present pending in the Courts in Hamburg.

In this connection it may interest operators to know that the Hamburg American Line has equipped the following vessels with contrapropeller type IV (combined streamline rudder and contrapropeller): the *Westphalia, Idarwald* and *Niederwald*, and has ordered contrapropellers of the same type for the following new vessels, orders for which have recently been placed with German shipyards:

No. 371 at the Flensburg Shipbuilding Yard—9,000 tons deadweight, 5,400 shaft horsepower.

No. 102 at the Deutsche Werft—9,000 tons deadweight, 3,700 shaft horsepower.

No. 104 at the Deutsche Werft—9,000 tons deadweight, 5,400 shaft horsepower.

No. 647 at the Bremer Vulcan Vegesack—9,000 tons deadweight, 5,400 shaft horsepower.

M. S. Rheinland at the Deutsche Werft—10,000 tons deadweight.

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Ship Construction and Repair Bids

Terminal Construction Bids

TENDERS for the construction of the terminal at New Castle, Delaware, were opened at the office of the Chapman and Fisher Company, consulting engineers and naval architects, 524 Walnut street, Philadelphia, Pa., on February 9, and the following bids were received:

Frederick Snare Corporation	$98,603
Simpson & Brown	122,344
J. E. Brenneman	124,740
Triest Contracting Corp	144,460

The award has not as yet been made.

Repair Bids to S.S. Terje

A CONTRACT for repairs to the steamship *Terje* has been awarded to the Morse Drydock and Repair Company, Brooklyn, New York, at a price of $5,750 and a time of 8 days, bids for which were received and opened recently at the office of Captain F. C. Halvorsen, 25 Beaver street, New York City. Other tenders received were:

	Price	Days
Tietjen & Lang Drydock Company	$6,850	10
James Shewan & Sons, Inc.	6,876	8
Robins Drydock and Repair Company	7,120	10
Todd Engineering, Drydock and Repair Company	7,285	11
Staten Island Shipbuilding Company	7,396	9
New York Harbor Drydock Company, Inc.	10,400	10

U. S. Engineer Office, Mobile, Receives Bids for Diesel Electric Harbor Tugboat

TENDERS were received and opened by the United States Engineer Office, Mobile, Ala., on February 7, 1927, for the construction of a steel Diesel-electric harbor tug. The tug is to have a length overall 101 feet 13-16-inch; breadth, molded, 22 feet; depth at side, molded, 10 feet 6 inches; depth at center line, molded, 10 feet 11½ inches; sheer forward at center line, molded, 4 feet ½-inch; and camber in 22 feet, molded, 5½ inches. The bids received were as follows:

	Price	Days
Jahncke Drydocks, Inc.	$21,500	18
Galveston Drydock and Construction Company	22,236	23
Alabama Drydock and Shipbuilding Company	22,273	15
Johnson Iron Works, Drydock and Shipbuilding Company, Inc.	31,693	30

Bids Received for Conditioning Liner America

TENDERS for the reconditioning of the steamship *America* were received and opened at the office of Captain R. D. Gatewood, manager of Maintenance and Repair Department of the United States Shipping Board, 45 Broadway, New York City, on Monday, February 21, with the following results:

	Price	Days
Newport News Shipbuilding and Drydock Company	$1,947,000	300
(Alternate)	1,894,000	360
Tietjen & Lang Drydock Company	1,980,000	Completion (December 24, 1927)
W. & A. Fletcher Company	2,249,950	Completion (December 24, 1927)
(Alternate)	2,215,000	(Completion (February 23, 1928)
Morse Drydock and Repair Company	2,250,000	Completion (December 24, 1927)
Separate bide for refitting public rooms were:		
J. C. Knipp & Sons	$99,990	
Rex Cabinet and Linoleum Company	119,000	(Work to be done at Boston or Norfolk)
(Alternate)	115,000	(Work to be done at New York)
George W. Smith Woodworking Company	140,190	(Work to be done at Norfolk)
(Alternate)	145,190	(Work to be done at Boston or New York)
Tietjen & Lang Drydock Company	162,585	

The bids were taken under advisement by the Merchant Fleet Corporation, and the contract awarded to the Newport News Company.

Repair Contract on Tanker Bulko

A CONTRACT for repairs to the tanker *Bulko*, recently in collision with the steamship *Creole* near Fort Point, in the Mississippi, 80 miles south of New Orleans, has been awarded to the Mobile plant of the Todd Shipyards Corporation, at a price of $19,865 and 16 days' time. The other bids received for the work were:

Shipping Board Receives Bids for Converting Three Ships to Diesel Engine Drive

BIDS were received and opened at the office of Captain R. D. Gatewood, manager of the Maintenance and Repair Division of the Shipping Board, 45 Broadway, New York, on Tuesday, February 15, for the installation of Diesel engines on the freighters *West Grama*, *Seminole* and *Yomachichi*. The tenders were as follows:

Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., offered to fit the *West Grama* for sea service as a motorship for $575,000; Morse Drydock Company, Brooklyn, New York, bid $625,000 to fit out the *Seminole;* Newport News Shipbuilding and Drydock Company, Newport News, Va., bid $527,500 to fit out the *Yomachichi;* Staten Island Shipbuilding Company, Staten Island, New York, bid $675,000 for the *Seminole*, while the Tietjen and Lang plant of the Todd Shipyards, at Hoboken, N. J., was the only company offering to fit out two vessels, their bid for the *Seminole* being $579,590, and the *West Grama*, $619,420.

The *Seminole* is to be equipped with a Hooven-Owens-Rentschler engine, Shipping Board conversion; the *Yomachichi* with a Busch-Sulzer engine, and the *West Grama* with a McIntosh and Seymour double-acting engine.

This leaves one ship to complete the fleet of 12, and it is understood that this vessel will be selected shortly and that she will be fitted with an M. A. N. type Diesel engine built by the New London Ship and Engine Company, Groton, Conn.

Name and Address of Bidders	Main Engine by Lombard Gov. Co.	Main Engine by Std. Motor Const. Co.	Main Engine by De LaVergne	Main Engine by Bethlehem	Main Engine by Bessemer	Main Engine by New London	Main Engine by Winton	Main Engine by Ingersoll-Rand	Time of Delivery	Remarks
CHARLES WARD ENG. WORKS, CHARLESTON, W. VA.	$163,500	$164,240	$167,282	$169,645	$172,331	$177,745	A $181,250* 174,870**	$182,620	360 days	For G-E Co., alternate contract equipment add $700 to either bid except A. See footnote.
CHARLESTON DRY DOCK & MACHINE COMPANY, CHARLESTON, S. C.		(1) 189,332 (2) 189,481	(1) 193,259 (2) 192,275				(1) 207,108 (2) 200,889		245 days 275 days	If alternate control is desired as specified in G-E proposal No. 2 add $650.
HOWARD SHIP YARDS & DOCK COMPANY, JEFFERSONVILLE, IND.	178,347	177,147			186,347	191,973	192,743		300 days	All G-E electrical equipment.
SOUTHERN SHIPYARDS CORP. NEWPORT NEWS, VA.		(1) 269,600 (2) 271,000	(1) 269,200 (2) 270,300	(1) 276,700 (2) 280,000			(1) 291,800 (2) 286,000	(1) 291,600 (2) 286,000	275 days	
NASHVILLE BRIDGE CO. NASHVILLE, TENN.	174,940	175,794	179,375	181,293	182,140	188,078	(2) 184,106	196,108	360 days	All G-E electrical equipment except as indicated.

Footnote: If direct connection desired substract $3,500 from low bid and substitute Fairbanks Morse Engine.
* and 1—General Electric electrical equipment.
** and 2—Westinghouse Electric Co., electrical equipment.

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Bids Received for Conversion of S.S. John Jay to Oil Tanker

TENDERS were received and opened at the office of Frank S. Martin and Son, naval architects, 25 Broadway, New York City, on Monday, February 14, covering the conversion of the steamship *John Jay* to a tanker, which was recently purchased from the United States Shipping Board by the American Tankers' Corporation, Boston, Mass. At the same time bids were received for the conversion of a second vessel. The proposals received were as follows:

	Conversion to tanker				General repairs to turbines (lump sum)	Installation work for new recip. engine
	One vessel	Time	2nd vessel	Extra tank		
Morse Drydock	$353,000	120	$353,000	$4,900	$15,975	$31,250
Maryland Drydock	384,933	195	364,933	13,526	15,923	58,969
Staten Island	398,600	135	.....	.....	18,900	35,200
Atlantic Works	438,000	120	(Alt.)	.....	10,750	25,000
	450,000	150				
Robins Drydock	449,000	140	.....	9,100	27,770	55,835
Tietjen and Lang	455,400	150	.....	9,320	28,718	56,795
Federal Shipbuilding	474,750	...	.....	.....	20,360	52,300
Newport News Shipbuilding	485,500	170	917,600*	.....	19,380	50,395

* Figure for two vessels.

No awards have as yet been made.

Proposals Received for Panama Canal Commission Diesel-Electric Dredge

TENDERS for furnishing by steamer, free of all charges, on dock at either Cristobal (Atlantic port) or Balboa (Pacific port) Canal Zone, Isthmus of Panama, one 24-inch Diesel-electric suction dredge complete in every respect, with the exception of crew's quarters, were received and opned by the general purchasing officer, the Panama Canal Commission, Washington, D. C., on February 11.

Four items were bid on as follows: Item 1, 1st proposition, suction dredge, complete, except crew's quarters; Item 2, 2nd proposition, same as 1st proposition, except not to include hull; Item 3, 3rd proposition, dredging machinery, including hull, fabricated ready for erecting and riveting, etc., but excluding engines, motors, etc.; Item 4, 4th proposition, dredging machinery, exclusive of hull and electrical equipment. The proposals submitted were as follows:

Bid 1. Bucyrus Co., South Milwaukee, Wis.:

Item 1, G. E. equipment, 4 units, $1,090,625; 3 units, $1,008,045. Allis-Chalmers equipment, 4 units, $1,110,635; 3 units, $1,027,835. Nordberg engines, G. E. equipment, 4 units, $1,067,535; 3 units, $990,500. Do. Allis-Chalmers equipment, 4 units, $1,086,400; 3 units, $1,009,550. Worthington, G. E. equipment, 4 units, $1,069,750; 3 units, $995,165. Do. Allis-Chalmers equipment, 4 units, $1,090,000; 3 units, $1,015,200; time, Cristobal, 430 days.

Item 3, 4 engines, $405,225; Cristobal, 275 days.

Item 4, with engines, Ingersol-Rand, 4 units, $514,650; 3 units, $451,585. Nordberg, 4 units, $486,190: 3 units, $428,640. Worthington, 4 units, $473,000; 3 units, $419,700.

Bid 2. Ellicott Machine Corp., Baltimore, Md.:

Bids are for Westinghouse and General Electric equipment.

Item 1, Worthington 4 cylinder, 4 units, $1,007,500 and $1,001,500; deduct for 1 unit, $63,500 and $62,700. Fulton, 5-K, $1,028,000 and $1,025,800; deduct for 1 unit, $55,500 and $54,700. Fulton, 5-K, $1,028,000 and $1,025,800; deduct for 1 unit, $68,506 and $67,700. McIntosh-Seymour, $996,900 and $999,900; deduct for 1 unit, $60,775 and $59,775. De la Vergne, $1,006,900 and $1,002,400; deduct for 1 unit, $62,640 and $61,840. Nordberg, $1,034,000 and $1,028,000; deduct for 1 unit, $70,040 and $69,240. Ingersol-Rand, $1,058,800 and $1,052,800; deduct for 1 unit, $76,500 and $75,700; Cristobal, 547 days.

Item 2, Worthington, $667,155 and $661,155; deduct for 1 unit, $61,300 and $60,500. Fulton, B. G., $636,755 and $630,755; deduct 1 unit, $53,500 and $52,750. Fulton, 5-K, $690,055 and $687,855; deduct for 1 unit, $66,800 and $66,000. McIntosh-Seymour, $658,755 and $652,755; deduct for 1 unit, $59,058 and $58,250. De la Vergne, $661,855 and $657,655; deduct for 1 unit, $59,300 and $58,500. Nordberg, $693,755 and $687,755; deduct for 1 unit, $67,800 and $67,000. Ingersol-Rand, $724,155 and $718,155; deduct for 1 unit, $80,200 and $79,600; Cristobal, 425 days.

Item 3, $451,305, Cristobal, 435 days.

Item 4, $198,280, Cristobal, 365 days.

Bid 3. No bid.

Bid 4. Morris Machine Works, Baldwinsville, N. Y.:

Item 2, McIntosh-Seymour, G. E. equipment, 4 units, $548,494; 3 units, $493,649. Westinghouse equipment, 4 units, $560,430; 3 units, $505,585. Ingersol-Rand, G. E. equipment, $603,413 and $535,962. Westinghouse equipment, $615,349 and $547,898. De la Vergne, G. E. equipment, $544,213 and $491,304. Westinghouse equipment, $556,149 and $503,240. Nordberg, G. E. equipment, $570,789 and $510,369. Westinghouse, $582,725 and $522,305. Washington Estep with G. E. equipment, $616,309 and $544,509. Westinghouse, $628,245 and $556,445; Worthington with G. E. equipment, $568,338 and $509,059; Westinghouse, $580,274 and $520,995; 8½ to 11½ months.

Bid 5. No bid.

Bid 6. Newport News Shipbuilding & Dry Dock Co., Newport News, Va.:

Bids are for either Westinghouse or G. E. equipment.

Item 1, 4 units, Worthington, $921,000. Fulton, $890,300. McIntosh-Seymour, $910,000. Nordberg, $932,300; 3 units, Worthington, $842,800. Fulton, $825,000. McIntosh-Seymour, $842,000. Nordberg, $856,200; time, Cristobal, 15 months; towing and insurance charge to Cristobal, $24,000.

Bid 7. American-Brown-Boveri Electric Corp., Camden, N. J.:

Electric dynamic or Ridgeway equipment.

Item 1, 3 units, New London S. & E. Mfg. Co. Co., 1,000 h. p., $980,000; Cristobal, 350 days; 3 Winton, 840 h. p., $975,000, 365 days; 4 Winton, do, $1,011,260, 365 days; 3 Worthington, 930 h. p., $990,000, 365 days; 4 do, $1,014,124, 365 days; 3 Ingersol-Rand, 825 h. p., $992,784, 400 days; 4 do, $1,017,403, 400 days.

Item 3, $550,000, Cristobal, 240 days.

Repair Bids for S.S. Gladysbee

BIDS were opened recently at the office of the Maintenance and Repair Division of the United States Shipping Board, 45 Broadway, for general repairs to the steamship *Gladysbee*. The following yards submitted proposals for the general specifications, including hull and engine work:

W. & A. Fletcher Company	$26,819
Morse Drydock and Repair Company	30,403
Staten Island Shipbuilding and Drydock Company	34,438
Merrill-Stevens Drydock and Repair Company	34,994
The Maryland Drydock Company	36,404
Robins Drydock and Repair Company	37,156
Federal Shipbuilding Company	39,844
New York Harbor Drydock Co., Inc.	39,875
Newport News Shipbuilding and Dry dock Company	43,000
Atlantic Basin Iron Works Corp.	49,200

In addition to the general contract, specifications were also issued covering electrical repairs. The following bidders submitted proposals for this work:

Holmberg Electrical Company	$1,930
Atlantic Basin Iron Works Corp.	1,985
Robins Drydock and Repair Company	2,075
Hart Electrical Company	2,530
Charles Cory & Son, Inc.	2,580

Contracts covering the two specifications have not as yet been awarded.

Westinghouse Co. Receives Contract for Coast Guard Cutter Machinery

A CONTRACT for furnishing turbo-electric propulsion sets and other electrical and miscellaneous equipment for the Coast Guard cutters *Nos. 45, 46* and *47*, has been awarded to the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., by the Treasury Department, United States Coast Guard, Washington, D. C., bids for which were received at Washington on January 25. The contract price is $106,700 per ship; delivery is to be completed by January 1, 1928.

The propelling machinery is quite similar to that which was furnished by the General Electric Company for the Coast Guard cutters *Tampa, Haida, Modoc* and *Mojave*.

Diesel Drive Survey Boat Contract Awarded

A CONTRACT for the construction of a Diesel sternwheel survey boat has been awarded to the Charles Ward Engineering Works, Charleston, W. Va., by the Mississippi River Commission, Dredging District, Box. 1017, Memphis, Tenn., at a price of $113,500, bids for which were received at Memphis on November 1, 1926. The boat is to have an overall length of 139 feet 6 inches; beam, molded, 24 feet; depth, molded, 5 feet 3 inches. The main engine will be a 220-brake horsepower 2-cycle, solid injection marine type Diesel engine fitted with direct reversing and air starting mechanism.

Cement Barges Ordered

IT is understood that a contract has been placed by the National Cement Company with the Midland Barge Company, Midland, Pa., for six barges. These barges are to have a carrying capacity of 1,200 tons each.

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Notes from the Great Lakes

Shipyards on the Great Lakes Busy with New Work; Repair Work Normal

A SURVEY of the big shipyards scattered around the Great Lakes shows more activity than since the world war days. Shipbuilding is now more active than it has been in any year since 1918. There does not appear, however, to be much definite encouragement for new work when the contracts now under way are completed. This condition on the lakes, however, is not new.

Nine large bulk freighters are at present on the ways. Four of these 600 footers are due for delivery on April 15, or when lake navigation opens. The other five are due for delivery before the end of the 1927 season. Beyond this program the lake shipyards have nothing in sight. The policy of hand-to-mouth buying is firmly established by the lake transportation companies. Much may happen, however, to mature tentative or dormant plans of vessel owners between now and the completion of the present ship construction program. A survey of all the existing bulk freighters now in lake service would show that many of them are still of the smaller and consequently less economical type of construction. These vessels can not move cargoes at as low a cost per ton mile as later day modern freighters and as a result their replacement at an early date is inevitable.

The only special type of freighters, not called bulk ships, being built at present at the yards are three car ferries, two at the Manitowoc Shipbuilding Corporation yards and one at the yard of the Toledo Shipbuilding Company, Inc. One of the nine carriers being built is to be of a special type in the sense it will carry cement and will have self-unloading machinery. This vessel is being built by the Great Lakes Engineering Works in Detroit for the Huron Transportation Company, of Detroit, a subsidiary of the Huron Portland Cement Company. She will be slightly larger but generally similar to the steamers *John W. Boardman* and *Samuel Mitchell* of the same company.

Another unusual and special type of freighter is being built by the American Shipbuilding Company at Lorain for the Bradley Transportation Company. She is 638 feet long, 65 feet beam and 33 feet deep, and will be one of the largest freighters ever put into service on the lakes. She will come out a self-unloader, similar to the *W. T. Robinson* built at the same yard for the same owners two years ago. Electrical power will be used both for propulsion and for operating the self-unloading machinery.

A few scows and non-propelled barges are also being built. It is reported that inquiries are being made calling for two small tankers, tentative proposals calling for Diesel propulsion machinery. Several cities on the lakes are also seriously considering the installation of fire boats.

Contrary to general opinion repair work is not now much greater than usual during February. This prevails despite the fact an early and severe winter interfered with operations at the season's close in 1926. Because of work the Toledo Shipbuilding Company is now employing 945 men as against 315 a year ago. Other yards have also an increased working force.

The keel for the freighter *Harry Coulby*, being built for the Interlake Steamship Company, of Cleveland, was laid at the Lorain yards, on February 7.

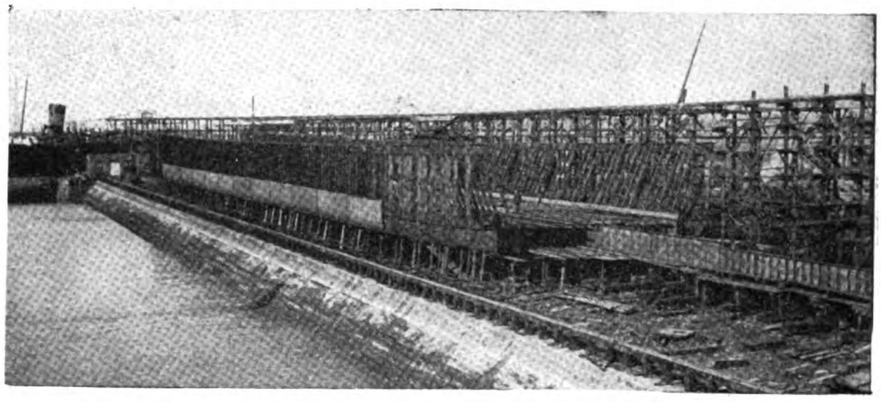
The passenger steamer *Illinois* of the Goodrich Transit Company has been dry docked at the Manitowoc yards for repairs. When the *Illinois* is released the same yard will repair the *L. E. Geer* of the Reiss Steamship Company which has a badly damaged bottom.

The American Shipbuilding Company is now working on the *William A. McLauchian*, *Robert Hobson* and *Harry Coulby* for the Interlake Steamship Company; the *George M. Humphrey* for the Kinsman Transit Company; the *L. E. Block* for the Inland Steel Company; the self-unloader *Hull 797* for the Bradley Transportation Company; two oil tank barges for the Standard Oil Company of New York, and a steel tug for the Bradley Transportation Company.

The Great Lakes Engineering Works is working on Hull No. 255, a bulk freighter for the Pittsburg Steamship Company, and Hull No. 256, a bulk freighter for the Huron Transportation Company.

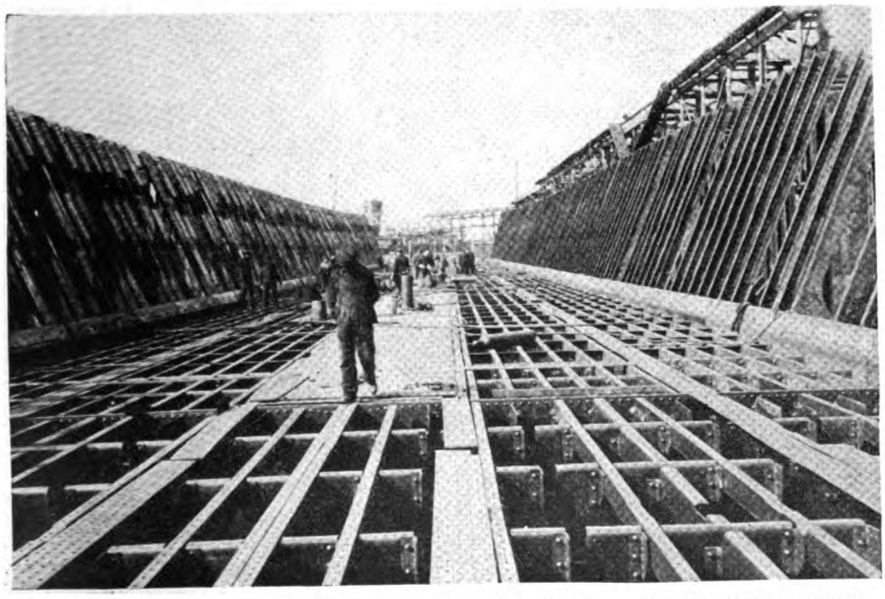
The Manitowoc Shipbuilding Corporation is at work on the *Grand Rapids* and the *Madison*, car ferries for the Grand Trunk Railway Company, and a Diesel dredge for the Great Lakes Dredge and Dock Company.

The Toledo Shipbuilding Company has in hand Hull No. 177, a car ferry for the Wabash Railroad, and Hull No. 178, a bulk freighter, for the Pittsburgh Steamship Company.



General view of the Interlake bulk freighter Harry Coulby on February 16

This vessel is under construction at the Lorain Plant of the American Shipbuilding Company for the Interlake Steamship Company, Cleveland, O. The principal dimensions are: Length overall, 630 feet; length between perpendiculars, 607 feet; beam, molded, 65 feet; depth, molded, 33 feet. The keel was laid on February 7 and in the first 4½ days of construction 949½ tons of fabricated steel were erected, bolted up and the riveting started.



View of the Harry Coulby from the tank top 10 days after the keel was laid

Great Lakes Yards to Submit Bids for Car Ferry

GREAT LAKES shipyards are preparing bids for the construction of one car ferry for the Pere Marquette Railroad, Detroit, Mich. The boat is to have a length of 362 feet, a beam of 53 feet and a depth of 29 feet.

Standard Oil Co. of Indiana to Ask New Bids for Oil Tanker

INFORMATION has been received that all bids recently received from Great Lakes shipyards for the construction of one or two Diesel oil tankers for the Standard Oil Company of Indiana have

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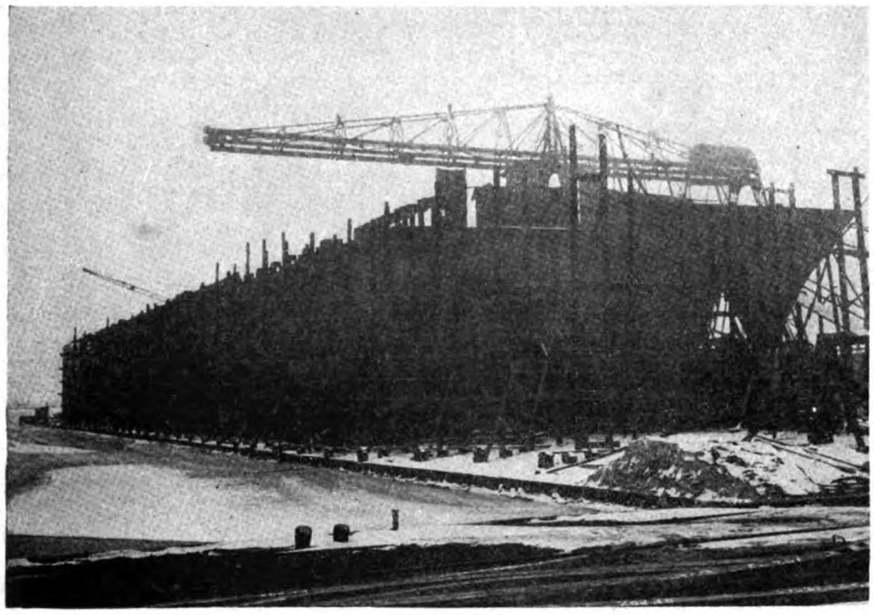


Hull of the bulk freighter A. F. Harvey under construction at the River Rouge yard of the Great Lakes Engineering Works for the Pittsburgh Steamship Company, Cleveland, O.

been rejected. New bids are to be called within a short time on revised specifications for the work. The tankers are to have a length of 360 feet. No definite date has been set as yet for the receipt of bids on the revised specifications which will be issued by the naval architect of the Standard Oil of New York.

Plans and Specifications Now Under Way for City of Buffalo Fireboat

IT is understood that plans and specifications for the construction of a fireboat for the city of Buffalo, New York, are now being prepared at the office of Cox and Stevens, naval architects, 347 Madison avenue, New York City. Plans have not yet reached the point where an announcement can be made of the particulars of this boat.

Standard Transportation Co. Orders Two Oil Barges for Lake Service

THE American Shipbuilding Company, Cleveland, Ohio, has been awarded a contract for the construction of two new oil barges for the Standard Transportation Company, New York. The barges are to be 258 feet long, 40 feet beam, 13 feet deep, and will have a capacity of 750,000 United States gallons of oil. It is estimated that it will take six months to construct the boats. The price involved was not made public.

Bradley Transportation Company Orders Tugboat

A CONTRACT for the construction of a tug for the Bradley Transportation Company, Rogers City, Michigan, has been awarded to the Lorain yards of the American Shipbuilding Company. The tug is to have a length of 95 feet, a beam of 24 feet and is to be delivered in 12 weeks' time. Steam is to be supplied at 160 pounds by one firebox boiler 11 feet by 14 feet 6 inches, to a compound engine, 20 inches by 40 inches by 30 inches stroke, developing 800 horsepower.

Chicago Oil Company Contemplates Construction of 350-Foot Lake Tanker

THE Roxana Oil Company, Chicago, Ill., a subsidiary of the Dutch Shell Oil Company, is contemplating the construction of one 350-foot tanker on the Great Lakes. Additional information will be available shortly.

Lumber Carriers Elect Officers

MEMBERS of the Lumber Carriers' Association of the Great Lakes at their annual convention in Detroit, on January 31, elected O. W. Blodgett, of Bay City, Mich., president; John O. Nessen, of Chicago, second vice president, and Captain H. C. Weeks, of Detroit, secretary. F. L. Leckie, of Cleveland, is a director.

The New Pittsburgh Freighters

THE two big 600 foot freighters which will be added to the fleet of the Pittsburgh Steamship Company this season will be named *A. F. Harvey*, after the president of the company, and *A. F. Affleck*, president of the Universal Portland Cement Company, both subsidiaries of the United States Steel Corporation. Mr. Harvey has been following the lake business all his career and was formerly with the Pickands, Mather and Company, owners of the Interlake Steamship Company, but 20 years ago went with the Pittsburgh company, succeeding Harry Coulby to the presidency three years ago, when Mr. Coulby resigned.

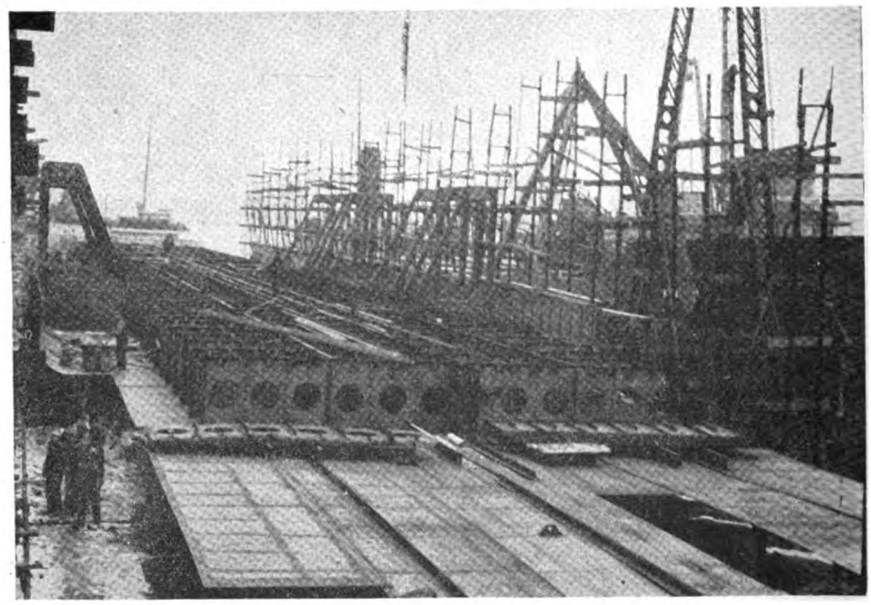
The *Harvey* is under construction at the River Rouge yards of the Great Lakes Engineering Works, the *Affleck* being built at the yards of the Toledo Shipbuilding Company. The two vessels will be sister ships, and are practically duplicates of the *Richard V. Lindabury* and *Josephus A. Hatfield*, added to the Pittsburgh Company's fleet in 1923.

Lake Carriers' Association Gives Dinner to Students at Its Schools

THE Lake Carriers' Association was host at the Hollenden Hotel, Cleveland, on the evening of February 14, to 60 students who are studying marine engineering and navigation under the direction of the organization. Twenty-five are taking the marine engineering course and more than 30 are taking the navigation studies. The students are taking final examinations for licenses which, if granted, will permit the young men to go aboard lake vessels as licensed officers.

Radio Direction Finders Being Fitted on Lake Vessels

A RADIO direction finder has been installed in the headquarters of the Upson-Walton Company, 738 Superior avenue, Cleveland, O., where practical demonstrations of the use of the instrument are given. It is the Continental



Construction of a 600-foot bulk freighter for the Pittsburgh Steamship Company, Cleveland, O., was begun last month by the Toledo Shipbuilding Company

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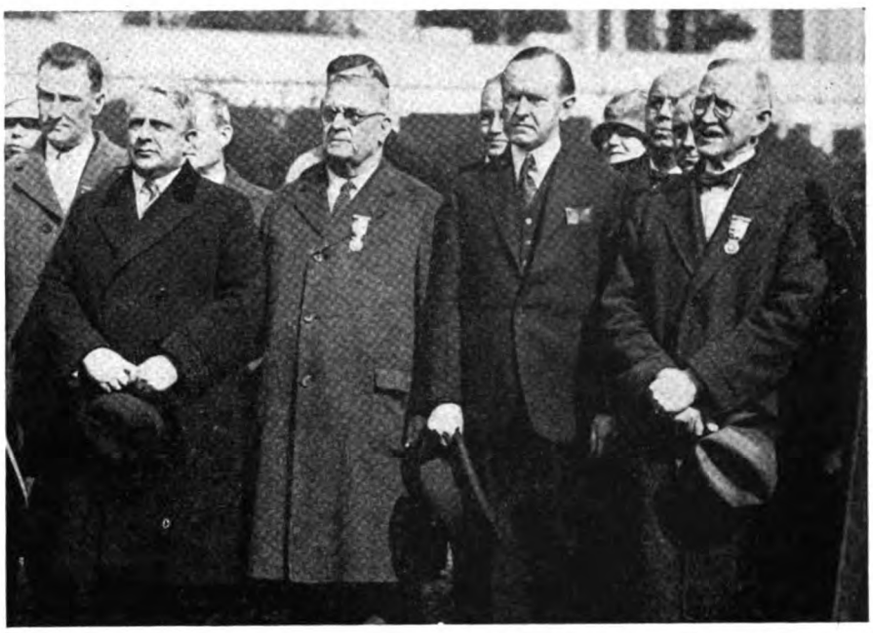
compass made by the Continental Radio Telegraph Company. A new instrument known as the simplified radio direction finder, Mark III, is announced by the Radio Corporation of America which maintains quarters at 1590 St. Clair avenue, Cleveland. Eleven vessels of the Reiss Steamship Company and the Rockport Steamship Company and ten vessels of the Columbia Steamship Company on the lakes will be fitted with radio direction finders by the Radio Corporation of America which is equipping 173 Great Lakes ships with this apparatus. D. S. Little, for many years with radio work on the lakes, has been made assistant superintendent of the Great Lakes division of the corporation and will be in charge of construction work and maintenance.

Freighter Niagara to Be Converted to Sand Sucker

THE steel lake freighter *Niagara*, which was recently sold by Boland and Cornelius of Buffalo, New York, to the Gravel Products Corporation of that city, is undergoing repairs at the Grove shipyard in Buffalo. She will be converted into a sand sucker. The *Niagara* is 255 feet long, 42 feet beam and will carry 2,500 tons of sand on a 15-foot draft. She will be equipped with a triple expansion engine and two Scotch boilers.

Bulk Freighter L. E. Block Launched

THE lake freighter *L. E. Block* of the Inland Steamship Company, managed by Hutchinson and Company, Cleveland, O., was launched at the Lorain yards of the American Shipbuilding Company, on February 1. Many prominent vessel owners, coal, ore grain and other shippers and business men were present from Cleveland, Toledo, Detroit, Buffalo, Sandusky and other cities. The *Block* is 620 feet overall, has a 64 foot beam and is 33 feet deep. She will be of all steel construction, is equipped with a triple expansion engine and Scotch boilers. She was christened by Miss Babette Block, daughter of L. E. Block, who is treasurer of the Inland Steel Company, of Chicago, owners of the Inland Steamship Company.



(Henry Miller News Picture Service, Inc.)

Marine engineers greeted by President Coolidge

President Coolidge, center, surrounded by members and officers of the National Marine Engineers Beneficial Association who called at the White House while holding their national convention in Washington last month. To the right of the President is W. F. Yates, New York, president of the body, and to the left is A. L. Jones, of Detroit, secretary, with Secretary of Labor James J. Davis, who presented the group to the President, to the left of him. Fifteen thousand marine engineers were represented by delegates at the convention.

Automobile Hauling Lines Sold

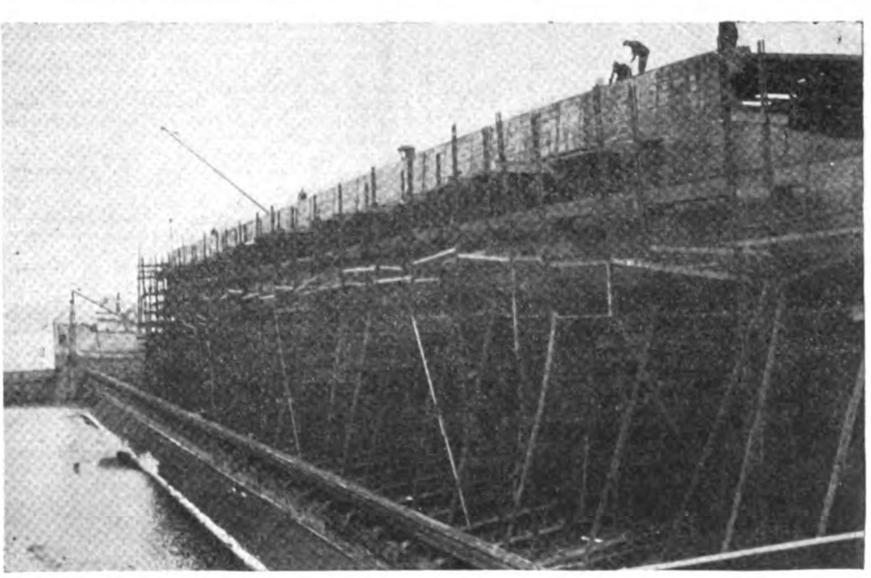
TWO Great Lakes concerns which have for several years specialized in hauling automobiles and serving the public as packet liners have sold their interests and will retire from the field. They are the Thompson Transportation Company, of Cleveland, and the Nicholson Transit Corporation, of Detroit.

Both concerns have sold their interests to the Universal Carloading and Distributing Company whose headquarters are in New York City. Along with the vessels of the Thompson and Nicholson organizations and good will go the personnel of both concerns. This will prevail especially with regard to the vessel crews and masters.

The Universal will devote about all its efforts to handling automobiles and carrying packet freight. The company has had some marine experience but its business has mostly been in lines other than transporting and distributing autos.

The Universal will have a Great Lakes fleet of eight ships and will get the steamers *Pope* and *Progress* of the Thompson fleet and the *Penobscot, Sultana* and *Sonora* of the Nicholson fleet, together with three wooden ships of the latter company. These are the *Fellowcraft, Roumania* and *Thomas Davidson.*

Freight steamer L. E. Block at the fitting out dock at Lorain



Car ferry for the Wabash Railroad Company being built by the Toledo Shipbuilding Company

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International Combustion Eng. Corp. Purchases Heine Boiler Co.

THE International Combustion Engineering Corporation recently purchased the capital stock of the Heine Boiler Company, one of the oldest and leading watertube boiler manufacturers in the United States. This acquisition gives the International Combustion Engineering Corporation large boiler shop facilities at St. Louis and Phoenixville, Pa.

TRADE PUBLICATIONS

GAS ANALYSIS INDICATOR-RECORDER.—The C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y., has issued a bulletin describing the new Tag-Mono-Duplex automatic gas analysis indicator-recorder.

WOLVERINE DIESEL ENGINES.—The Wolverine Motor Works, Inc., Bridgeport, Conn., has extended its line of oil engines to include sizes down to 25 brake horsepower. These engines are described briefly in a bulletin issued by the company.

MARINE STEAM GENERATING SET.—An improved marine steam generating set built by Engberg's Electric & Mechanical Works, St. Joseph, Mich., is described in a bulletin now being issued. The subject matter of the bulletin consists essentially in listing the distinctive features of this type unit.

ARC WELDING ACCESSORIES.—The General Electric Company, Schenectady, N. Y., has issued a folder describing various accessories for use in arc welding, including a hand shield for operators, helmets for operators, various types of holders, scratch brushes, welding table and the like.

DUPLEX STRAINERS.—The Morton Engineering Company, Philadelphia, Pa., is distributing a folder descriptive of the "MECO" duplex or twin strainer. This strainer, which is of the suction type, is so designed that one strainer may be cleaned while the other is in operation.

SIGNAL EQUIPMENT.—Charles Cory & Son, Inc., New York, is now distributing a bulletin on signal equipment including annunciators, bells, buzzers and the like. The subject matter treats of audible and visible fire alarms, call bells, automatic winding signals, stewards, nurses, attendants and messenger calls and the like.

JACK-O-LITE.—This is a new type of electric lantern which is operated by a magneto type generator which furnishes current for a standard 2.2 volt Mazda bulb. The Slaymaker Manufacturing Company, Philadelphia, Pa., outlines the many uses for the Jack-O-Lite both ashore and for marine service in a bulletin recently issued.

INTERNATIONAL STEAM SEPARATOR.—The Argus internal steam separator, manufactured by the Carew-Greene Engineering Company, Inc., New York, is the subject of a catalogue now being distributed. Details of the development of this separator from the first installation in 1911 to the present time for railway, stationary and marine service are in the catalogue.

OXYGEN MANIFOLDS.—With the increasing use of pipe line distribution of oxygen and acetylene in industrial and other plants the Air Reduction Sales Company has developed the Airco Davis-Bournonville Oxygen manifold which may be obtained for any number of cylinders desired. These manifolds have been made the subject of a pamphlet recently issued by the Air Reduction Sales Company.

BURMEISTER & WAIN SHIPYARD.—Burmeister & Wain, Ltd., engineers and shipbuilders, Copenhagen, Denmark, has issued a catalogue describing the shipyard which is located at the entrance to the harbor of Copenhagen. The layout and equipment of the plant are well shown by means of numerous photographs of the yard and shops. A large portion of the catalogue is taken up with photographs and deck plans of numerous well known vessels built by Burmeister & Wain.

BUSINESS NOTES

Charles A. Devlin & Company have been appointed Philadelphia representatives for the American Republics Line, representing the interests of C. H. Sprague & Sons, Boston, Mass., who recently obtained the allocation of the service withdrawn from the management of Moore & McCormack, who operated the ships for a year for the Shipping Board.

Garvey & Palmer, Inc., 420 East 3rd Street, Los Angeles, Cal., have been appointed Pacific coast marine representatives by the Foos Gas Engine Company, Springfield, Ohio. The firm of Garvey & Palmer will have charge of the distribution of Foos engines particularly in connection with marine installations.

The International Combustion Engineering Corporation recently announced its removal to the new International Combustional Building, Madison Avenue, corners of 35th to 36th streets, New York. The American subsidiaries of this company, including the Combustion Engineering Corporation, the Ladd Watertube Boiler Company and Raymond Bros. Impact Pulverizer Company, Inc., have also been allotted space in this building.

The Bridgeport Brass Company, Bridgeport, Conn., has announced that Raymond H. Liefeld has been appointed to the sales staff of the Bridgeport Brass Company, handling flush valves made by the company.

Peter A. Sensenig, who has been connected during the past year with the Ingersoll-Rand Company, and assigned to do their advertising and publicity on marine and stationary oil engines, has established the Peter A. Sensenig Service Bureau, at 10 West Scott avenue, Rahway, N. J.

The Lidgerwood Manufacturing Company of New York has established an office and warehouse at Jacksonville, Fla., 401 Barnett National Bank Building. This office will be in charge of L. C. Hastings, who has been traveling this territory for several years, selling the Lidgerwood line of winches.

R. H. Farley, who retired recently from active service as passenger traffic manager of the International Mercantile Marine Company, New York, has opened an ocean travel agency 535 Fifth avenue, in association with his son, R. S. Farley, under the name of the Farley Travel Agency. The Farley Travel Agency will represent the leading transatlantic and coastwise lines.

Marine Societies

America

American Marine Association. 30 Church St., New York. President—Col. E. A. Simmons.

American Marine Standards Committee. Chairman, Colonel E. A. Simmons. Secretary, A. V. Bouillon, Division of Simplified Practice, Department of Commerce, Washington, D. C.

American Society of Marine Designers. Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass.

American Society of Marine Engineers. 605 Market St., San Francisco, Calif. President—Henry F. Gelhaus. Secretary—Wm. H. Thille.

American Society of Naval Engineers. Navy Department, Washington, D. C. Secretary-Treasurer—Commander H. B. Hird, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

American Steamship Owners' Association. 11 Broadway, New York. President—Alfred Gilbert Smith.

Atlantic Coast Shipbuilders' Association. 1600 Walnut Street, Philadelphia, Pa. Secretary—C. S. King.

Council of American Shipbuilders, Inc. 30 Church St., New York. President—Homer L. Ferguson. Secretary-Treasurer—Henry C. Hunter.

Jersey Marine Club, 4th and River streets, Hoboken, N. J. President—Col. Bartlett.

Lake Carriers' Association. President—J. S. Ashley. Secretary—George A. Marr, Rockefeller Building, Cleveland, O.

National Association of Engine and Boat Manufacturers. 29 West 39th Street, New York City. Secretary—Ira Hand.

National Association of Masters, Mates and Pilots. National Secretary—M. D. Tennis-wood, 308 Vine St., Camden, N. J.

National Marine Engineers' Beneficial Association. Headquarters, 311-315 Machinists Building. Washington, D. C. President—Wm. F. Yates. Secretary—Albert L. Jones.

National Merchant Marine Association. Munsey Bldg., Washington, D. C. President—Hon. J. E. Ransdell.

Neptune Association. 21 Pearl St., New York City. Secretary-Treasurer—Captain John F. Milliken.

New York and New Jersey Dry Dock Association, 111 Broadway, New York. President—Jonathan Moore.

Ocean Association of Marine Engineers. 15 Whitehall St., New York. Secretary—Bert L. Todd.

Port of New York Authority. 75 West Street, New York. Chairman—George S. Silzer. Secretary—Wilson J. Vance.

Society of Naval Architects and Marine Engineers. 29 West 39th Street, New York. Secretary and Treasurer—Daniel H. Cox.

The Maritime Association of the Port of New York. 78 Broad St., New York City. President—John Dowd. Secretary—John F. Manning.

The New York Tow Boat Exchange. 11 Moore St., New York. Manager—Charles A. Mason.

The Propeller Club of the Port of New York. President—Edward A. Colson, 85 Liberty Street, New York. Secretary—William C. Gray, 17 Battery Place, New York.

United States Naval Institute. Naval Academy, Annapolis, Md. Secretary and Treasurer—Captain H. A. Baldridge, U. S. N.

United States Ship Operators' Association. 149 Broadway, New York. President—Winchester Noyes.

Canada

Grand Council N. A. of M. E. of Canada. Grand Secretary-Treasurer—W. A. MacDonald, 62 Albert St., Halifax, N. S.

Great Britain

Institute of Marine Engineers, Incorporated. 85/88 The Minories, London, E.1.

Institution of Engineers and Shipbuilders in Scotland. 39 Elmbank Crescent, Glasgow.

Institution of Naval Architects. Adelphi Terrace, London, W. C.

Northeast Coast Institution of Engineers and Shipbuilders. Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

France

Association Technique Maritime et Aéronautique. Secrétariat Général—7, rue de Madrid, Paris (8e).

Italy

Collegio Degli Ingegneri Naval e Meccanici in Italia.

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